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Original Articles

FORSYTH ORTHODONTIC SURVEY OF UNTREATED CASES

Edward I. Silver, D.M.D., Boston, Mass.

THIS paper represents a report of the orthodontic research survey of untreated cases at the Forsyth Dental Infirmary, Boston, covering a period of more than ten years.

Our aim has been to observe and note the changes which have taken place in the growth and development of the teeth and jaws at regular intervals without orthodontic aid.

Four hundred and five cases have come under our observation which were started as early as possible, the average age of the patient being about 3 or 4 years. In this study 342 were classified and reported. Cases selected for study represent a cross section of the average child—those with various habits, anomalies, premature loss of deciduous teeth; these included Angle's Class I, II, and III cases. We accordingly had the opportunity of watching the direction of growth and development under apparently favorable as well as unfavorable beginnings.

We have had a very fair measure of success in getting the cooperation of patients to return at regular intervals. All who have had experience with clinic work of this type well know the problem of getting patients to cooperate over a period of years.

Many of the cases that failed to cooperate and so prevented our continuing with our study, may be assumed to have become worse and so have probably become active cases elsewhere, for many a mother grew impatient when she saw the child's teeth getting crowded and felt that nothing was being done, with the result that in many instances that type of case did not return. However,

From the Forsyth Dental Infirmary for Children, Boston, Mass.
Read before the American Association of Orthodontists, Chicago, Ill., April 27, 1944.

we took pains to promise future active orthodontic treatment if the case needed it, provided that they would continue to report for observation.

In collecting our data, we were particularly anxious to learn the general health, diet, hereditary characteristics, musculature, and habits of the patient, as well as to study the occlusion itself.

FORSYTH DENTAL INFIRMARY FOR CHILDREN
ORTHODONTIC RESEARCH CLINIC

Name | Address | Case No.
Nationality | Age | Date of Birth | Classification | Operator, Dr.
Acidosis | Hereditary Characteristics
Diseases Congenital | T. B | Breast Fed - Length of Time
Childhood Diseases - At Age | Bottle Fed - Length of Time

Date Examined										
Imp. for models										
Photos										
X Rays I. O. F										
Extra Oral										
Profile										
Condyles										
General Health										
Height										
Weight										
Diet										
Oral Hygiene										
Caries (Degree)										
Ton. & Ad.										
Sucking Thumb										
Finger										
Cheek										
Tongue										
Lip										
Biting Nail										
Lip										
Mouth Breathing										
Swallowing										
Grinding Teeth (Night)										
Imitation in Class III cases										
Pillowing										
Posture										
Muscular Tone										
Faulty Speech										
Habits formed and broken										
Frenum										
Extractions										
Median line (Max										
(Man										
Study Models Pogue										
Stanton										
Open bite										
Over bite										
Cross bite										
Rotations										
Dec. Inc. Spacings										
Sym.-Max.-A-P										
Lat										
Sym.-Man.-A-P										
Lat										
Harmony of width of Jaws										
Tendency to Class II										
Tendency to Class III										
Loss of contact of										
Delayed Dentition										
Over retention										
Premature extractions										
Comp. size of Dec. & Per. Teeth										
Vertical growth of teeth										
Changes in A-P relations										
Congenital absence										
Supernumeraries										
Calcification Crowns										
Roots										
Remarks										

Fig. 1.—Chart used for collecting data.

Every patient, when first seen, had impressions taken for casts, in addition to a complete history, photographs, and thorough x-ray examination. We were fortunate in also having a complete physical examination by a pediatrician, and a thorough nutritional checkup. This procedure was repeated annually.

From the casts, we undertook to study the changes over a period of time: the symmetry of the arches, harmony of width, anterior-posterior relationship, effects of delayed dentition, relationship of deciduous incisor spacings to the permanent dentition, premature extractions of deciduous teeth without space maintainers, overretention, and certain aspects of vertical growth.

Forsyth Dental Infirmary for Children

MEDICAL DEPARTMENT

Case No ________ Age ________ Date ________

Name ________

Family physician: **Address:**

Last visit for illness? **For health exam.?**

Clinic or Hospital:
Last visit for illness? For health exam.?

STANDARDS

General Appearance (Judge on)

a. Gain in weight.
b. Musculature.
c. Subcutaneous fat.
d. Mucous membranes.
e. Expression (appearance of vitality).
f. Posture.
1-2-3 Slight, moderate or marked variation from optimum.

Posture

1. Head sl. forward. Chest sl. lowered. Lower abdomen in but not flat. Back curves sl. increased.
2. Head forward. Chest flat. Abdomen relaxed. Back curves exaggerated.
3. Head markedly forward. Chest depressed. Abdomen protuberant. Back curves extremely exaggerated.

Rickets

1. Harrison's groove, (1 sign).
2. Harrison's groove, plus rosary, high palate, etc., (at least 2 signs).
3. At least 3 signs present in marked degree.

Tonsils

1. Sl. enl. pale, smooth but not interfering with breathing or swallowing. Acutely red.
2. Interfering with breathing or swallowing even though smooth. Cryptic whether large or small with small tonsillar glands.
3. Cryptic with large tonsillar glands oozing of pus.

Do not mark 2 and 3 without review of history

Nose

1. Acute coryza. Septum deflected enough to partially occlude nares.
2. Chronic nasal obstruction (partial)
3. Adenoid facies or marked mouth breathing.

Glands (cervical)

1. A few shotty glands.
2. Easily palpable but not tender.
3. Acutely swollen; one very large one. Discharging gland.

Heart

1. Murmurs obviously functional.
2. 2-3 All other conditions according to severity.

CODE

0—Normal 2—Moderate defect Y—Irremediable defect T—Under treatment
1—Slight defect 3—Marked defect 00—Adequate correction I—Improvement

Fig. 2.—General medical appraisal chart made by pediatrician.

Our objective has been to gain some information as to what may be accepted as normal developmental changes, as distinguished from deviations from normal which may definitely become progressive deformities of the teeth and jaws.

The question has often been asked: "If this case had not been treated, what might we expect Nature to do? Will spurts of growth make up for early retarded growth and development?"

The thumb-sucking habit has led to such questions as: "Does it cause a deformity? Does the deformity correct itself if the habit is stopped; and if so, at what age will Nature make the necessary corrections? At what age should cases be treated? Should we wait until the permanent dentition erupts, before beginning treatment? What may be disclosed from this and similar group studies?"

Case No. ____________

Forsyth Dental Infirmary
Boston, Mass.

CHILD HEALTH RECORD

Name ____________ Address ____________
Date of Birth ____________ Sex ____________ Nationality of Father ____________ Mother ____________
Time in U. S. Father ____________ Mother ____________ Weekly Income ____________ Religion ____________

MEDICAL SUMMARY

Diseases in Family: Tuberculosis ____________ Rheumatism ____________ Carditis ____________ Hemophilia ____________
Diabetes ____________ Epilepsy ____________ Lues ____________ Insanity ____________ Asthma ____________ Eczema ____________
Remarks: ____________

Prenatal History: Mother's age at birth of child ____________ No. older children ____________ Ages ____________
No. younger children ____________ Ages ____________ No. miscarriages ____________ No. stillbirths ____________
Medical supervision begun at ____________ Nausea ____________ Vomiting ____________
Complications of pregnancy ____________
Diet: Daily amt. milk ____________ Vegetables ____________ Fruit ____________ Meat ____________ Sweets ____________
Remarks: ____________
____________ Outdoors: ____________
Dental care during pregnancy ____________
Labor: Normal ____________ Prolonged ____________ Delivery: Normal ____________ Caesarian ____________ Inst. ____________
Baby: Full term ____________ Premature ____________ Birth wt. ____________
Lactation period: Diet: Daily amt. milk ____________ Vegetables ____________ Fruit ____________
Dental care ____________
Baby: Breast fed for ____________ mo. Breast and bottle fed for ____________
Bottle fed for ____________ mo. Formula ____________
Orange juice begun at ____________ mo. Amt. ____________ until ____________
Cereal begun at ____________ mo. Amt. ____________ until ____________
Vegetables begun at ____________ mo. Amt. ____________ until ____________
Eggs begun at ____________ mo. Amt. ____________ until ____________
Cod liver oil begun at ____________ mo. Amt ____________ until ____________
Medical supervision ____________
Baby's first tooth at ____________
Remarks: ____________

Disease	Age	Disease	Age	Disease	Age	Operations	Age
Acute Intestinal Disturbance		Pertussis		Mumps			
		Measles		Chicken pox			
Croup		Scarlet Fever		Diphtheria			
Skin		Bronchitis					

Treatment at Hospital ____________
Treatment at Clinic ____________
Treatment by private Doctor ____________
Vaccination ____________ Toxin-Antitoxin ____________ Tuberculin ____________

Fig. 3.—Complete medical summary of child's health and past history.

I believe our findings, although not conclusive, point to a new and interesting knowledge, the value of which will increase as further observations are made and more material becomes available, and thereby aid our judgment in our clinical decisions.

It might be of interest at this point to give some details on the incidence of malocclusion.

In the course of our investigation, the orthodontic staff examined 839 children as they appeared at the general clinic, to determine how early the malformations occurred and to observe the degree of their severity.

In the study of our charts we found a very striking rise in the incidence of malocclusion as the age increased.

In our first group, from the age of 2 to 6 years inclusive, out of a total of 390 cases examined, 51 per cent had a definite malocclusion.

At once it might be well to pause for a moment and regard this high percentage of malocclusion in such a young group as a warning that care should


Case No. Name
Date
Appetite
Regularity of meals
Milk
Vegetables: Raw
Cooked
Fruits
Cereals
Bread
Meat or Fish
Eggs
Fat
Cod liver oil
Tea or coffee
Water
Constipation
Sleep
Outdoors
Activity
Cooperation

Date
Breakfast Amt. Breakfast Amt. Breakfast Amt.
Noon meal Noon meal Noon meal
Night meal Night meal Night meal

Fig. 4.—Chart for complete nutritional survey.

TABLE I

INCIDENCE OF MALOCCLUSION

839 CASES

AGE	2	3	4	5	6	TOTALS	%
Malocclusion	3	23	47	60	65	198	51
Normal	3	25	59	64	41	192	49
Patients examined	6	48	106	124	106	390	
AGE	7	8	9	10		TOTALS	%
Malocclusion	26	31	35	26		118	59
Normal	27	16	24	14		81	41
Patients examined	53	47	59	40		199	
AGE	11	12	13	14	15	TOTALS	%
Malocclusion	32	35	43	34	22	166	66.5
Normal	21	21	20	15	7	84	33.5
Patients examined	53	56	63	49	29	250	

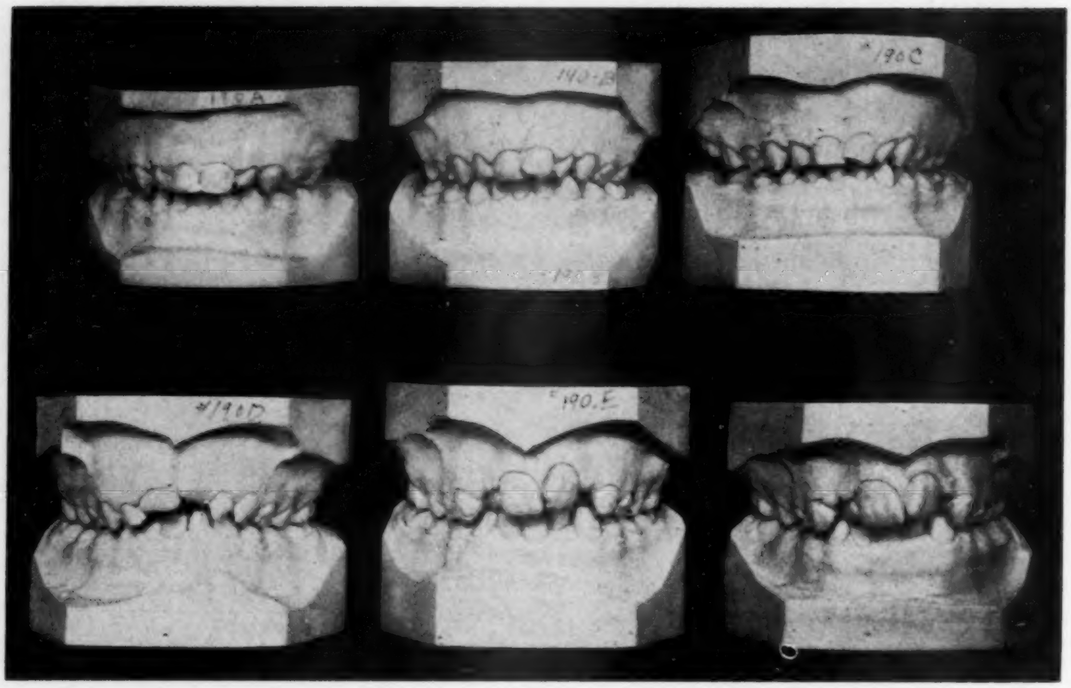


Fig. 5.—Case 190. Front view of models showing pronounced malocclusion. History presents a poor medical background, many childhood diseases, underweight, and poor nutrition. Models show progress of general lack of development, and a resulting collapse of arches with insufficient space to accommodate permanent teeth. Models range from the age of 3 years, 6 months to 10 years, 1 month.

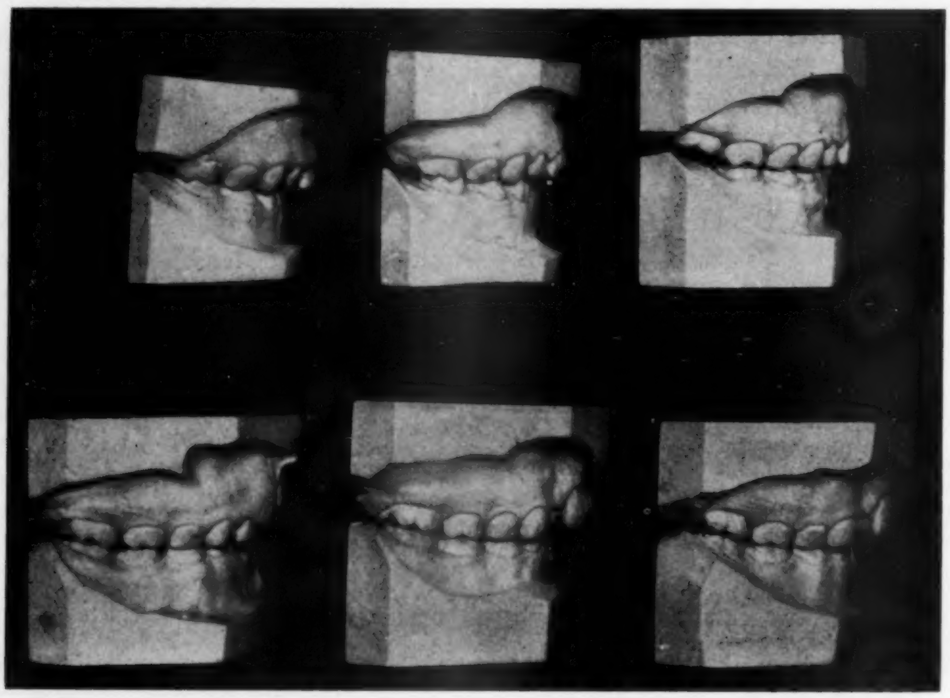


Fig. 6.—Case 190. Side view of models showing the progress of the malocclusion.

be exercised in observing the child at an early age so as to be on guard against a more severe deformity.

In the next group, from the age of 7 to 10 years inclusive, 199 children were examined, with 59 per cent showing a definite malocclusion.

In the third group, from the age of 11 to 15 years inclusive, of 250 children, we found the highest percentage of malocclusion, namely 66.5 per cent.

Fig. 7.—Case 190. Occlusal view showing progress of narrow arch and high vault and crowding of incisors.

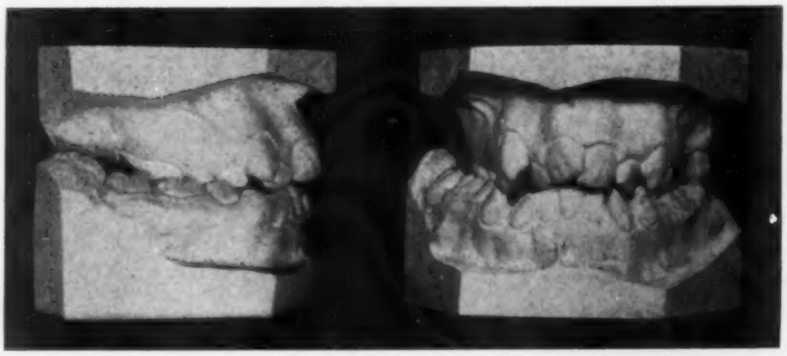


Fig. 8.—Cast made of mother of Case 190, to show similarity of alignment of incisors and narrow arches as an indication of the possibility of strong hereditary influences.

We felt that there were various factors coming into the picture as the child grew older, which would tend to increase the incidence and severity of the problem and thus account for the rise.

Important factors responsible in part, at least, for the gradual rise were caries and the premature loss of teeth with the resulting loss of space, as will be shown later in this paper.

The influence of hereditary characteristics, nutrition, general health, and habits would also tend to manifest themselves as the child grew older.

As regards thumb-sucking, we have had the opportunity to study forty cases and have made several interesting observations.

Fig. 9.—L. McL., aged 2 months. This case of micrognathia from the Children's Hospital, Boston, came under my observation and I introduce it here to show that some of our distoclusion deformities in various degrees may have their beginnings in this type of problem.

TABLE II

THUMB-SUCKING

40 CASES

	Class I	Class II	Class III	
Worse 65%	9	16	1	26 Cases
Improved 15%	4	2		6 Cases
Same 20%	8			

Twenty-six, or 65 per cent, of the cases became progressively worse, and of this group, as the chart indicates, there were nine Class I, sixteen Class II, and one Class III cases.

Inasmuch as 16 out of 26, or 63 per cent, of those that became worse were Class II cases, it might be considered a fair inference that the habit may have contributed to the distal relationship.

Only six cases, or 15 per cent, showed any improvement. In this group there were four Class I, and two Class II cases. The improvement consisted of a change in the anterior segment and not in the distal relationship.

Eight, or 20 per cent, remained unchanged by the habit; and of particular interest is the fact that they were all Class I cases.

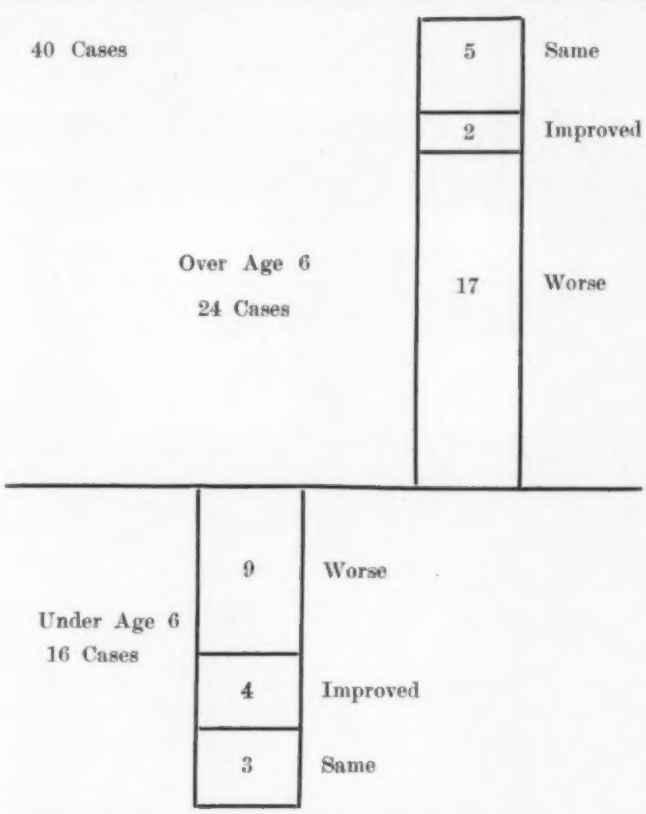
Of course we must consider that there may be many other factors that influence the changes that take place, some more far-reaching than we can explore here; perhaps the most important one to consider is the time of the cessation of the habit.

In the next chart we find one important fact that stands out, namely, if the habit is stopped after the age of 6 years, the chances for improvement are not as good as when stopped under the age of 6 years.

TABLE III

THUMB-SUCKING

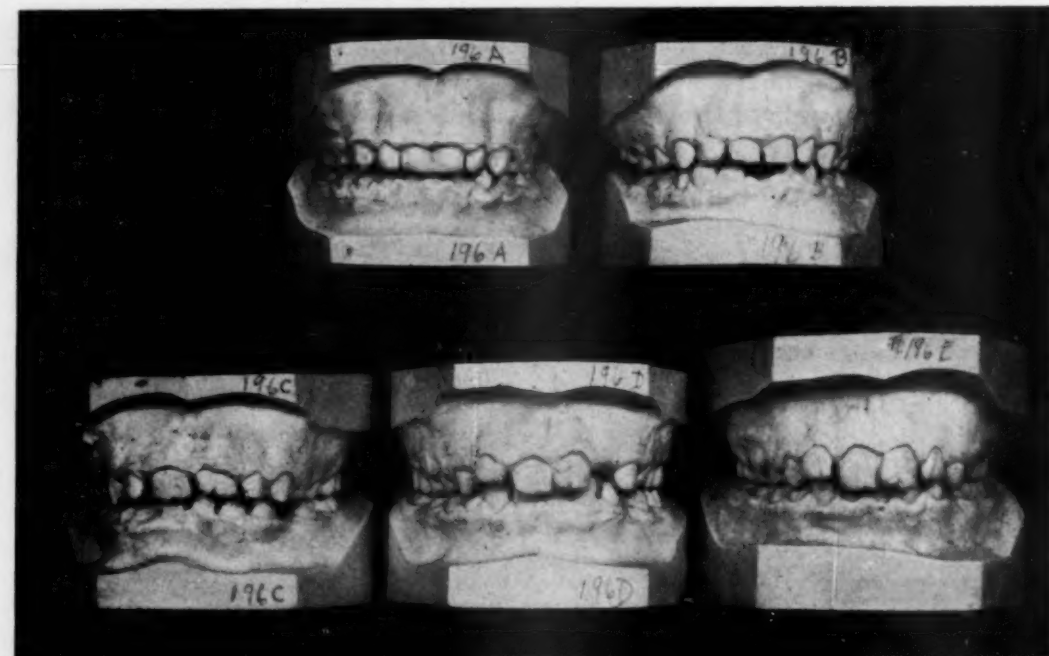
PROGRESS OF DEFORMITY WITH RELATIONSHIP TO THE AGE AT WHICH HABIT WAS STOPPED



In twenty-four out of forty, or 60 per cent of the cases, the habit was stopped after the age of 6 years, and, of these 24 cases, seventeen, or 71 per cent, became worse, whereas only two, or about 8 per cent, of the cases showed any improvement when the habit was stopped after the age of 6 years.

In the sixteen cases where the habit was stopped under 6 years of age, nine, or 56 per cent, still became worse, but four, or 25 per cent, did improve.

Fig. 10.



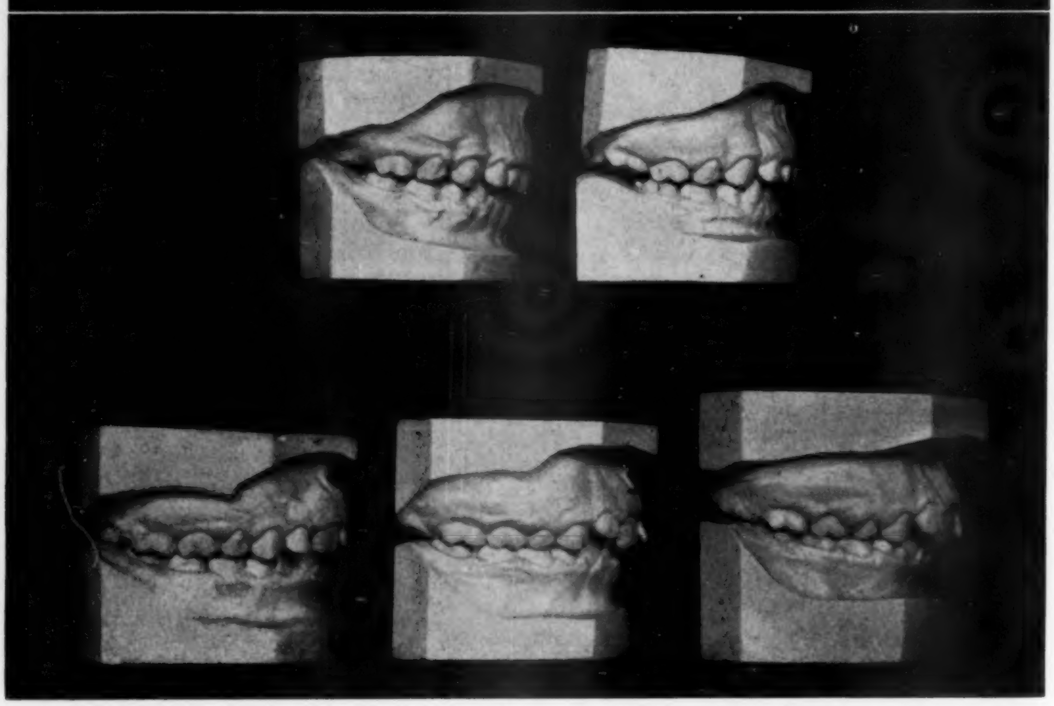


Fig. 11.

Fig. 10.—Case 196. Front view. B. L., twin sister. These models are one series of a set of twins showing a Class II progressive deformity from the age of 6 years to 11 years, 3 months, to be compared with twin brother (Case 356) who has a Class III malocclusion.

Fig. 11.—Case 196. B. L. Side view showing Class II relationship of arches.

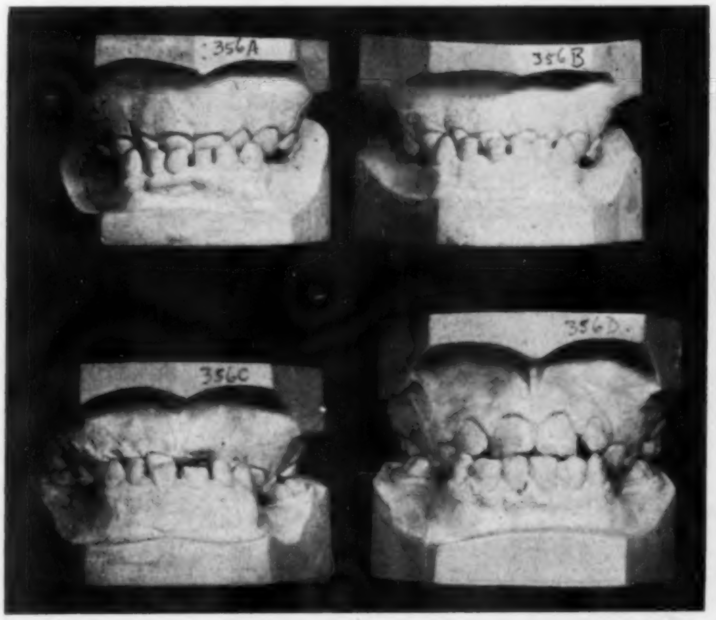


Fig. 12.—Case 356. L. L., twin brother. Class III. Front view of models showing incisal relationship. Models range from the age of 5 years to 10 years, 2 months. Interesting fact is that here we have a twin sister and brother, one Class II, the other Class III. No history of Class II or Class III relationship in either parent.

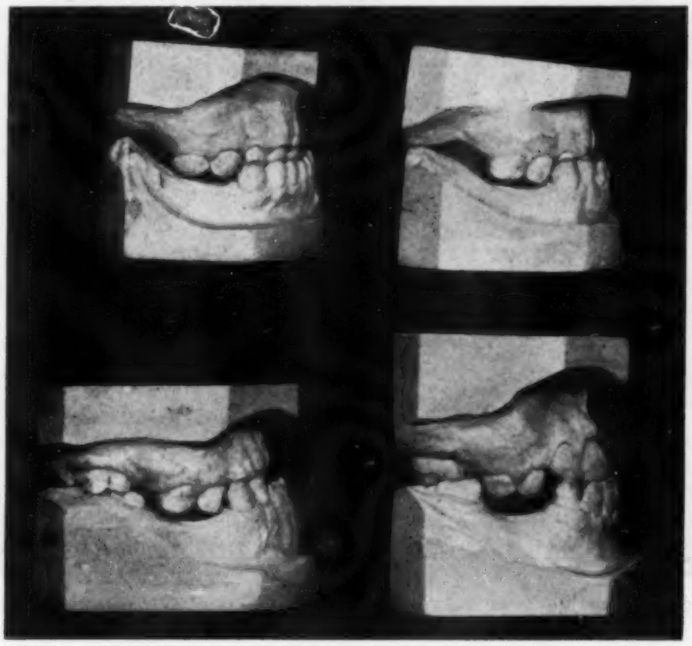


Fig. 13.—Case 356. L. L. Side view of models showing progress of strong Class III tendency.

Fig. 14.—Broadbent profile x-rays of triplets, showing the congenital absence of mandibular second premolars in all three children.

The evidence from these charts would indicate that regardless of the age at which the habit was stopped, a large percentage of the cases were affected by the thumb-sucking habit, but also that they stood a better chance for self-correction if the habit was stopped early enough.

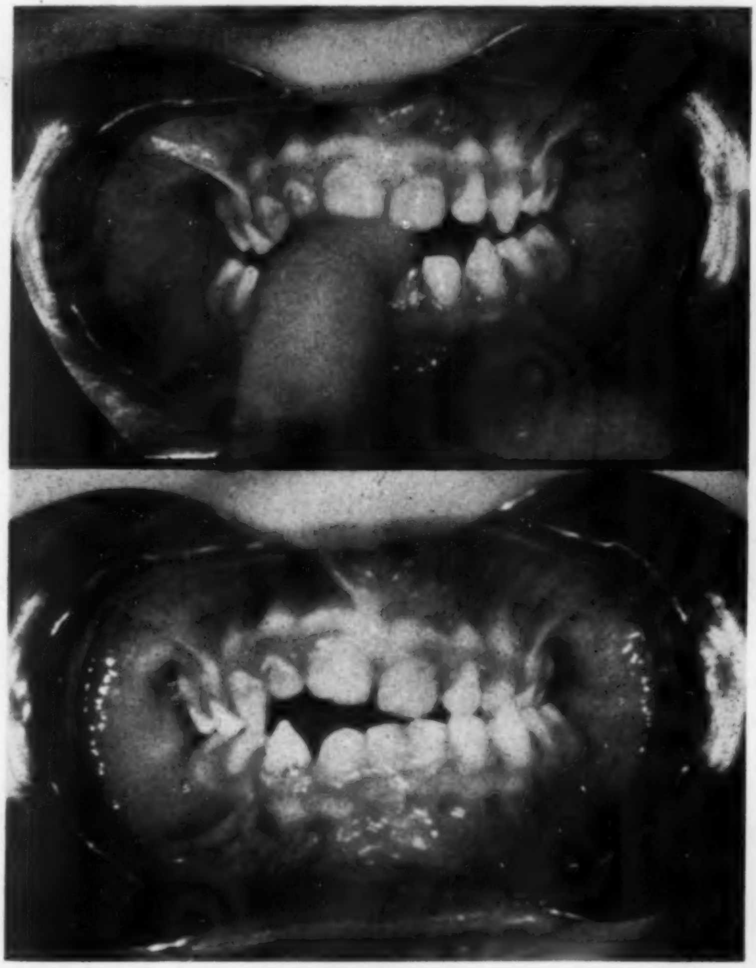


Fig. 15.—Two photographs showing finger-sucking habit, demonstrating the direct relationship between the habit and the deformity.

Furthermore, if we are correct in assuming that thumb-sucking is a cause of these conditions, we feel that we should not hesitate to make common knowledge of these facts as an important health measure, so that pediatricians would not encourage mothers to continue the habit. Not infrequently we are told by the mother that she was advised to teach her baby to suck its thumb as a pacifier.

In the August, 1943, issue of the American Journal of Orthodontics and Oral Surgery, Dr. H. C. Pollock, in an editorial entitled "Physicians and Thumb-Sucking," states: "The average medical man knows clinically little about local habits as an etiological factor in malocclusion because he has never struggled for months to help correct the incidental anomalies."

Fig. 16.

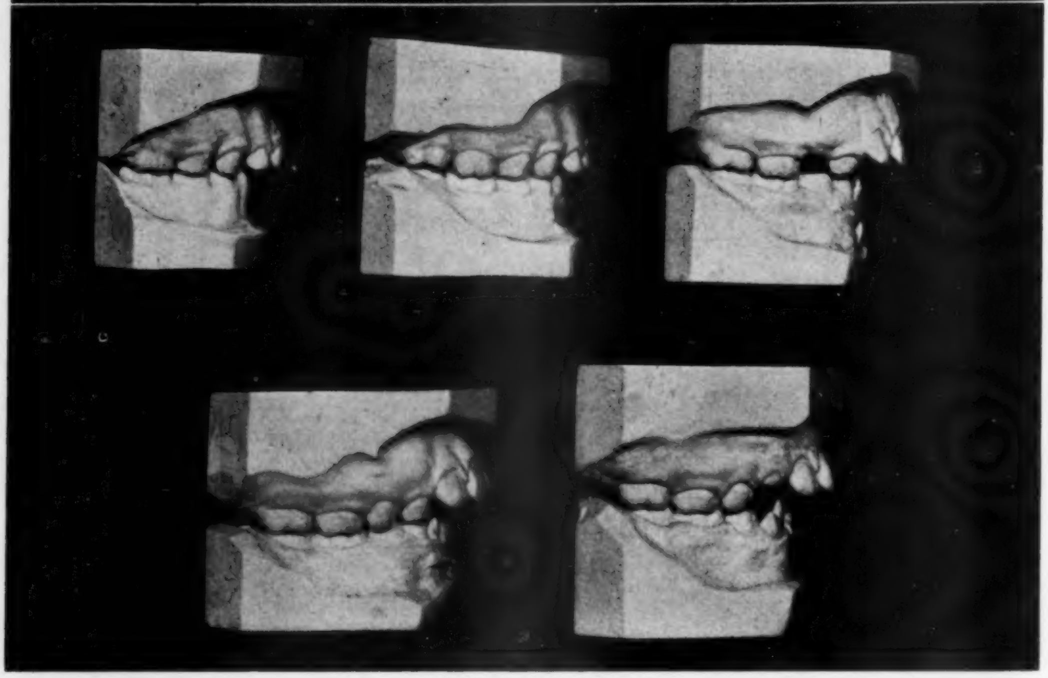


Fig. 17.

Fig. 16.—Case 174. W. L. Typical thumb-sucking malocclusion which failed to correct itself. Habit stopped at 8 years of age.

Front view shows progress of deformity resulting in a high vault and severe protrusion of maxillary incisors. Models range in age from 5 years to 11 years, 9 months.

Fig. 17.—Case 174. W. L. Side view of thumb-sucking case. Protrusion of maxillary incisors persists throughout.

The problem of open-bite cases has haunted orthodontists for a long time. The etiology of open-bites, their treatment, the problem of retention, and the question whether or not self-correction would take place, have been the chief stumbling blocks.

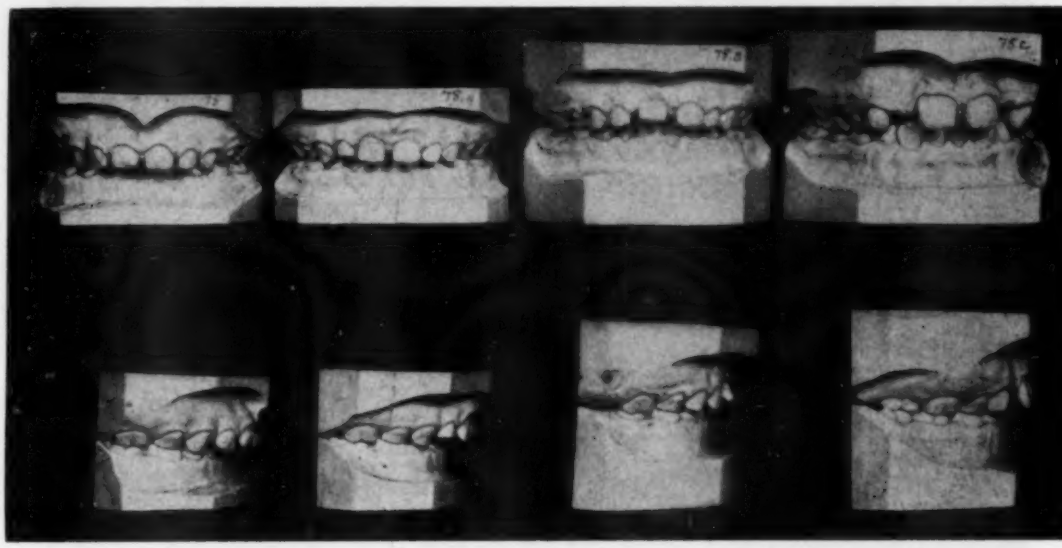


Fig. 18.—Case 78. M. W. Front and side views of models showing severe malocclusion as a result of lip-sucking. Habit stopped at the age of 5 years.

Models show progress of maxillary anterior protrusion and lack of growth of the mandibular anterior segment, apparently a result of the muscular forces preventing normal growth from taking place. Models range from the age of 4 years to 8 years, 6 months.

Table IV

Open-Bite

15 Cases

	Class I	Class II	Class III	Total
Worse 60%	4	1	4	9 Cases
Improved 40%	4	2		6 Cases

All open-bite Class III cases became worse.

Out of 342 cases studied, we found 15 open-bite cases. These were kept under observation without mechanical stimulation.

Nine of these cases, or 60 per cent, became worse as time went on, whereas six, or 40 per cent, improved.

Of those cases that became worse, we had four Class I, one Class II, and four Class III cases.

The six cases that improved were made up of four Class I and two Class II cases. There were no Class III cases in this group.

In other words, all of the Class III open-bite cases we observed became worse.

Fig. 19.

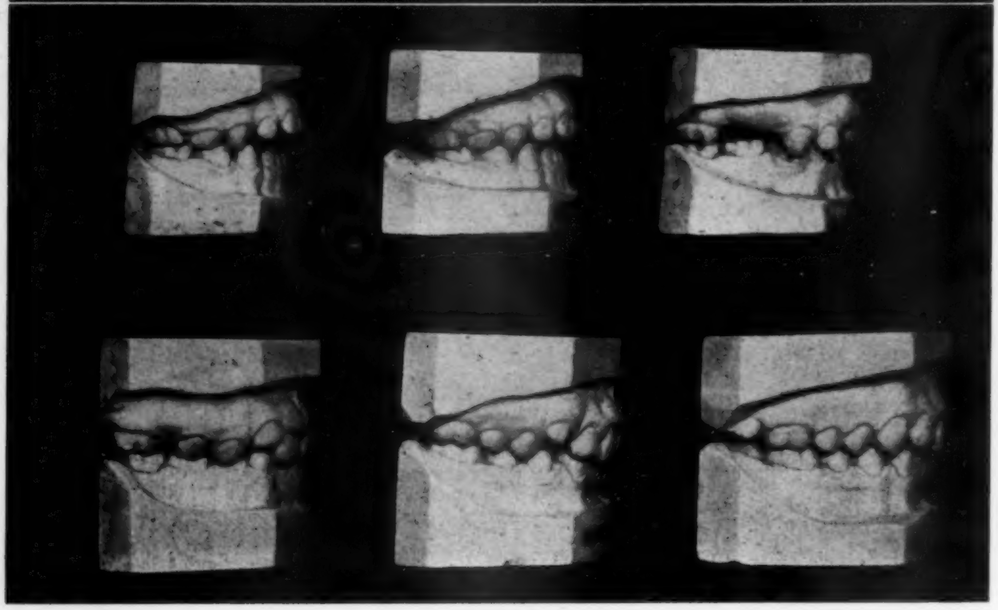
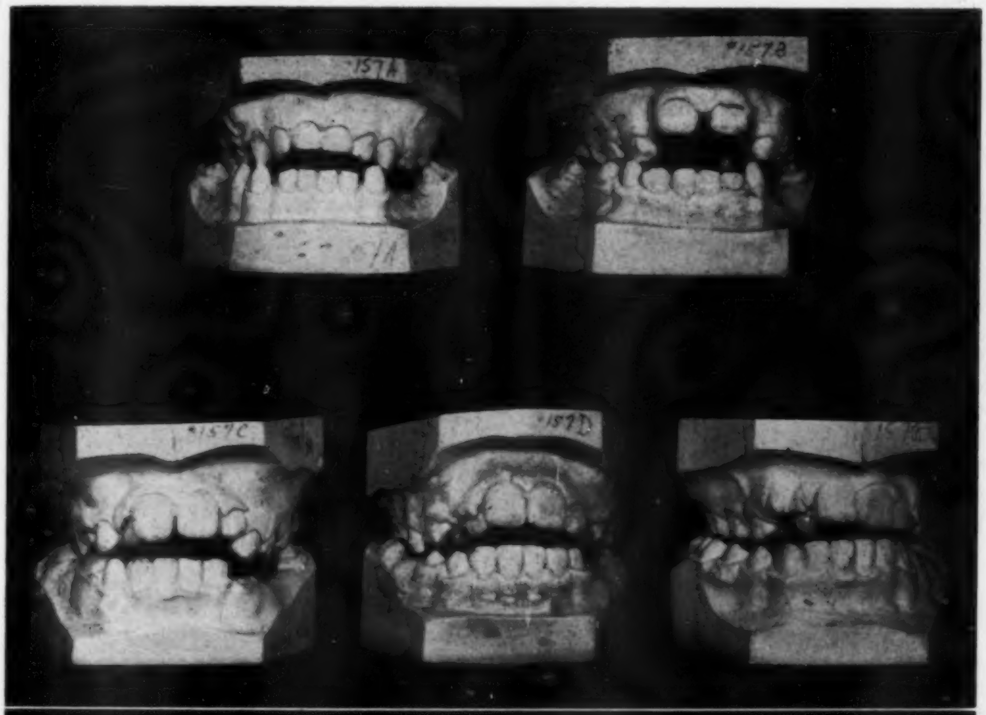


Fig. 20.

Fig. 19.—Case 132968. Front view. Thumb-sucking case which improved without mechanical stimulation, resulting in a very satisfactory occlusion. Habit was stopped at the age of 4 years. Models range from 4 to 13 years of age.

Fig. 20.—Side view, same case, showing excellent anterior-posterior relationship of arches and good overbite.

Fig. 21.



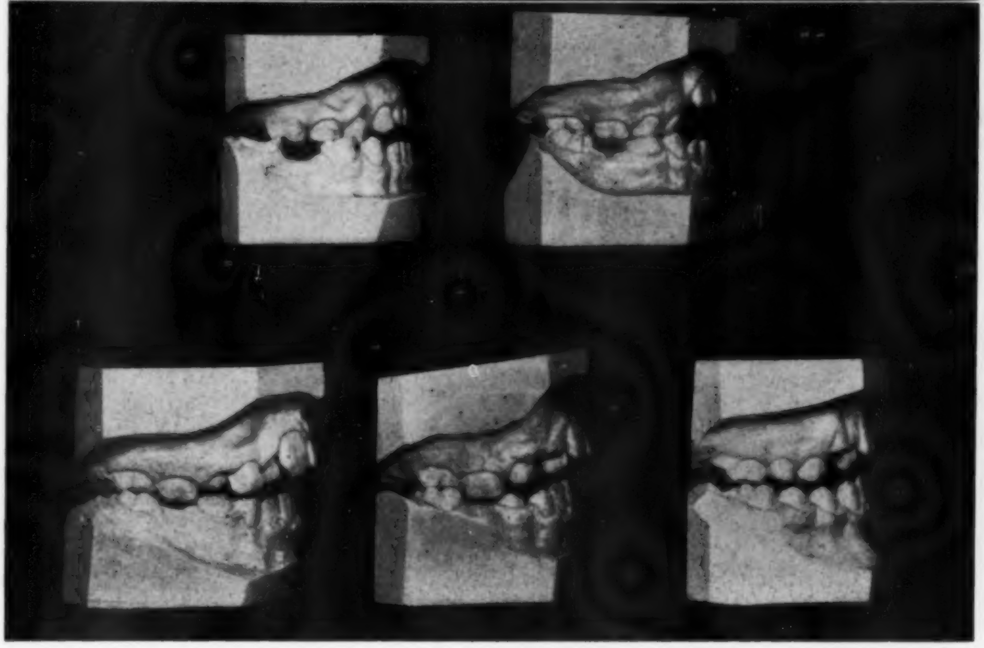


Fig. 22.

Fig. 21.—Case 157. J. D. Front view. Models from 5 to 10 years of age. Open-bite case which became progressively worse.

Fig. 22.—Side view. Models of same open-bite case. Last model shows occlusion striking only on first molar on each side.

In the Class I cases the chances for improvement were equal. This might suggest careful observation of Class I cases, particularly to watch the trend of growth before determining the time for treatment.

Our next subject is the premature loss of deciduous teeth.

Fig. 23.—Case 158341. Open-bite case which did correct itself. First model at the age of 4 years shows open-bite condition which gradually improved without mechanical therapy, and last model shows overbite within range of normal at 11 years of age.

TABLE V

Premature Loss of Deciduous Teeth

158 Cases

	Incisors		Canines		1st Molars		2nd Molars			
	Max.	Mand.	Max.	Mand.	Max.	Mand.	Max.	Mand.	Totals	%
Space Maintained	3	0	0	2	8	16	6	10	42	26.5%
Space Lost	2	0	6	8	17	29	22	34	116	73.5%

In our group of cases we did not find many deciduous incisors prematurely lost, as indicated by the chart.

When we come to the canine teeth, we find our first evidence of value; out of six maxillary deciduous canines prematurely lost, in every instance the

space was lost. And in the mandibular arch, in eight out of ten cases the space was lost as a result of the premature loss of the canines.

In the loss of the first deciduous molars (maxillary), the chart indicates that in 17 out of 25, or 68 per cent, of the cases the space was lost, and that only in 8 out of 25, or 32 per cent, of the cases was the space maintained.

Fig. 24.

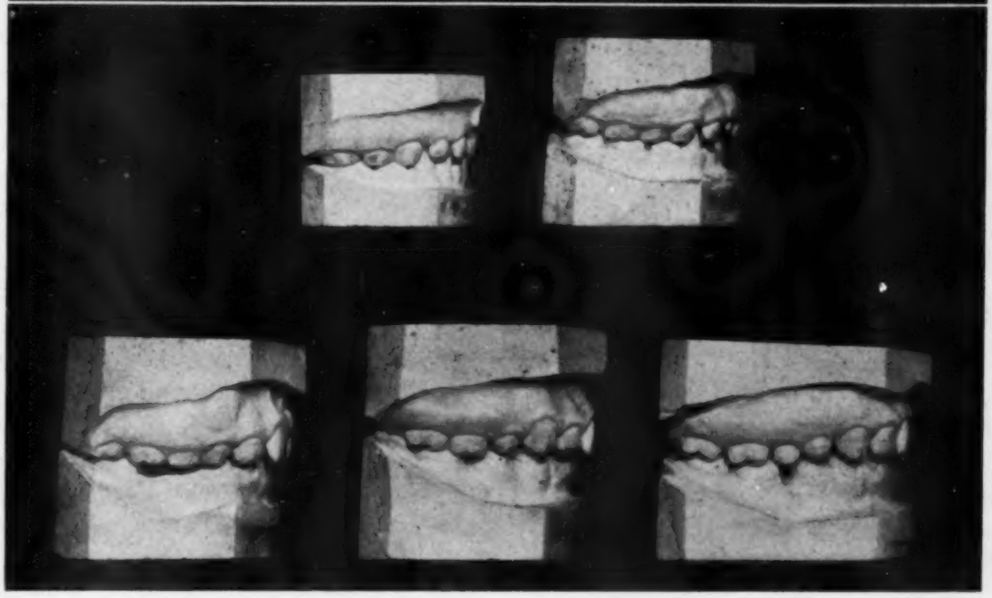


Fig. 25.

Fig. 24.—Case 148872. Occlusal view showing the locking out of the mandibular second premolar due to the loss of space.

Fig. 25.—Side view of same case showing premature loss of deciduous molars causing the drifting of teeth resulting in loss of space. Models range from 5 to 12 years of age.

In the loss of the first deciduous molars (mandibular), the chart indicates that in 29 out of 45, or 64.5 per cent, of the cases the space was lost, and that in 16 out of 45, or 35.5 per cent, of the cases the space was maintained.

In the loss of the second deciduous molars (maxillary), the chart indicates that in 22 out of 28, or 78.6 per cent, of the cases the space was lost, and that in 6 out of 28, or 21.4 per cent, of the cases the space was maintained.

In the loss of the second deciduous molars (mandibular), the chart indicates that in 34 out of 44, or 77.3 per cent, of the cases the space was lost, and that in 10 out of 44, or 22.7 per cent, of the cases the space was maintained.

The important fact stands out that the loss of the second deciduous molars, either maxillary or mandibular, is more vital to the maintenance of space for the eruption of the permanent teeth than that of the first deciduous molars.

But the most important factor in summarizing is that the premature loss of any deciduous canine or molar will usually result in the loss of space in whole or in part.

At this point, to correlate with a previous statement, let me say that I believe the increase in the incidence of malocclusion as the age increases may be considered in part due to the premature loss of deciduous teeth.

Certainly this should bring to mind the dentist's responsibility in the care of deciduous teeth, and also the value of space maintainers, and of careful observation to guard against loss of space whenever a deciduous tooth is lost prematurely; and this notwithstanding statements made in the past that there is never need for a space maintainer, that Nature would keep the space open, or open one up when it was time for the eruption of the permanent teeth.

TABLE VI

GROUP CLASSIFICATION

342 CASES

	Class I 235 Cases			Class II 88 Cases			Class III 19 Cases		
	IMP.	WORSE	SAME	IMP.	WORSE	SAME	IMP.	WORSE	SAME
	47	123	65	0	67	21	0	17	2
Percentages	20	53	27	0	76	24	0	89	11

In our group classification, we wish to start with the statement that of Angle's three classes, the Class I cases by far had the best chance of becoming self-corrective. However, only 20 per cent of this group showed improvement.

In our study of 235 Class I cases, we had 47 which improved (or 20 per cent), 123 which grew worse (or 53 per cent), and 65 which remained the same (or 27 per cent). In view of the fact that even 20 per cent of the Class I cases improved, it would justify our following a program of making record models as early as possible and observing the trend by comparing with models taken at later dates.

Since 53 per cent of our Class I cases became worse, it certainly would be advisable to keep close observation on any Class I case in its early stages. Sixty-five (or 27 per cent) remained unchanged, indicating that the Class I cases as a group are the most favorable.

The study of our Class II cases indicated that the chances for self-correction in this group were very poor; for, of a total of 88 cases studied, 67, or 76 per cent, became worse, 21, or 24 per cent, remained the same, and none of the cases showed any improvement in the distal relationship.

Fig. 26.

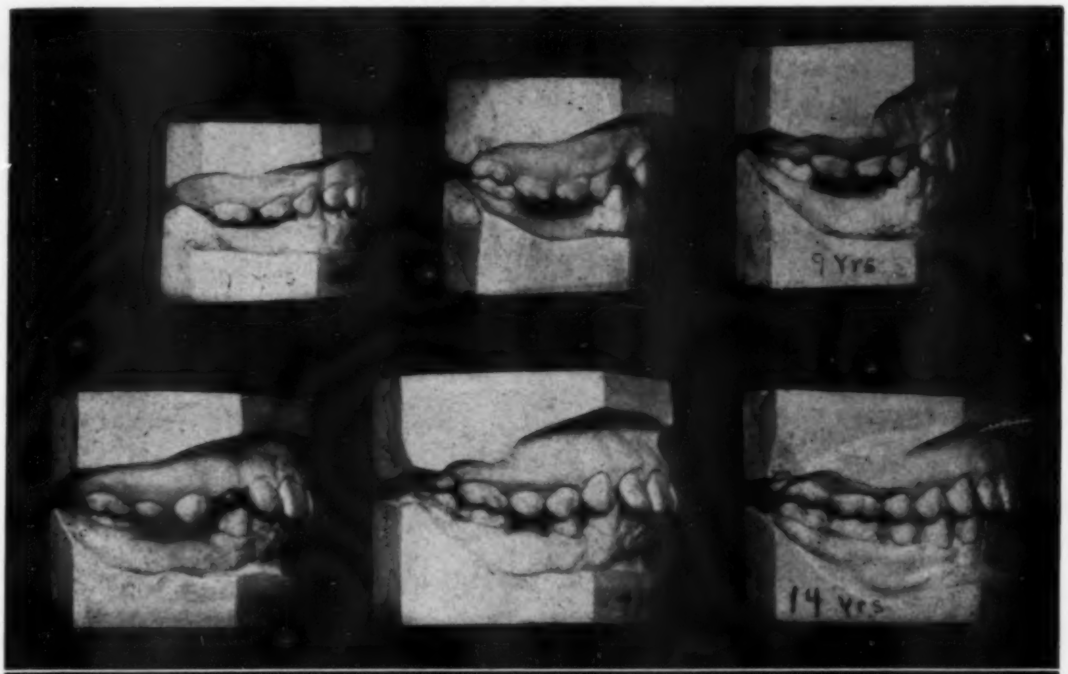
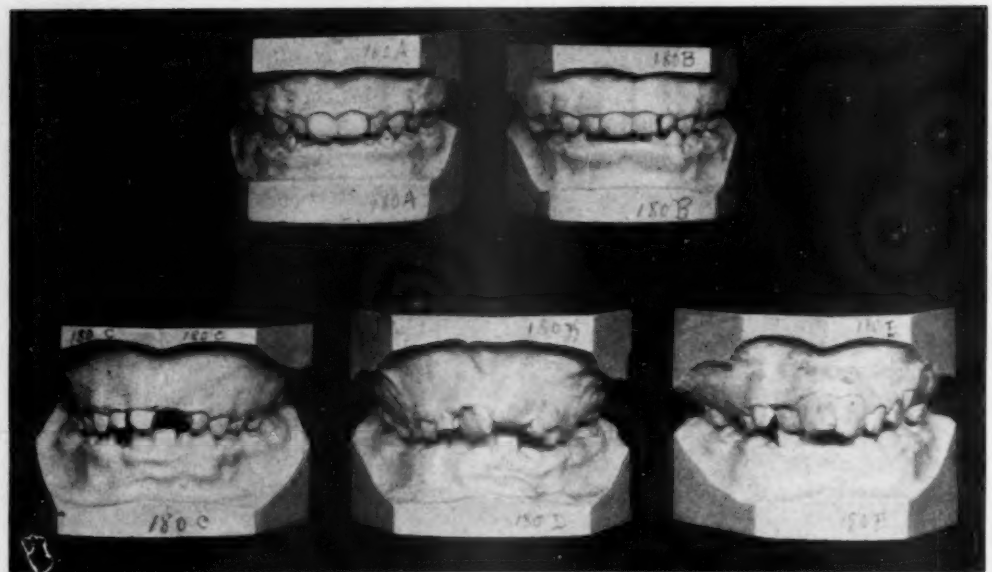


Fig. 27.

Fig. 26.—Case 143078. Right side. Series of models showing premature loss of deciduous teeth without space maintainer with space preserved for permanent teeth. Models from 7 to 14 years of age.

Fig. 27.—Same case, left side. Series of models showing premature loss of deciduous teeth with space preserved for permanent teeth (in spite of small malformed second premolar, space was still being maintained for a normal-sized tooth).

Fig. 28.



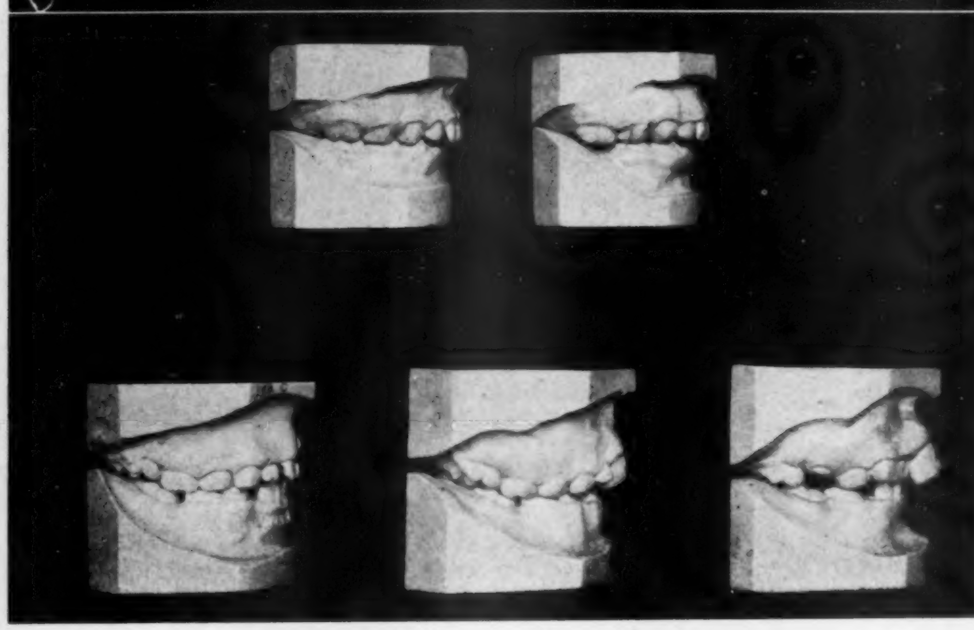


Fig. 29.

Fig. 28.—Case 180. Class I. Front view. Series of models from 3 to 9 years of age showing progressive malocclusion with severe collapse of arches and crowding of incisors.

Fig. 29.—Same case, side view.

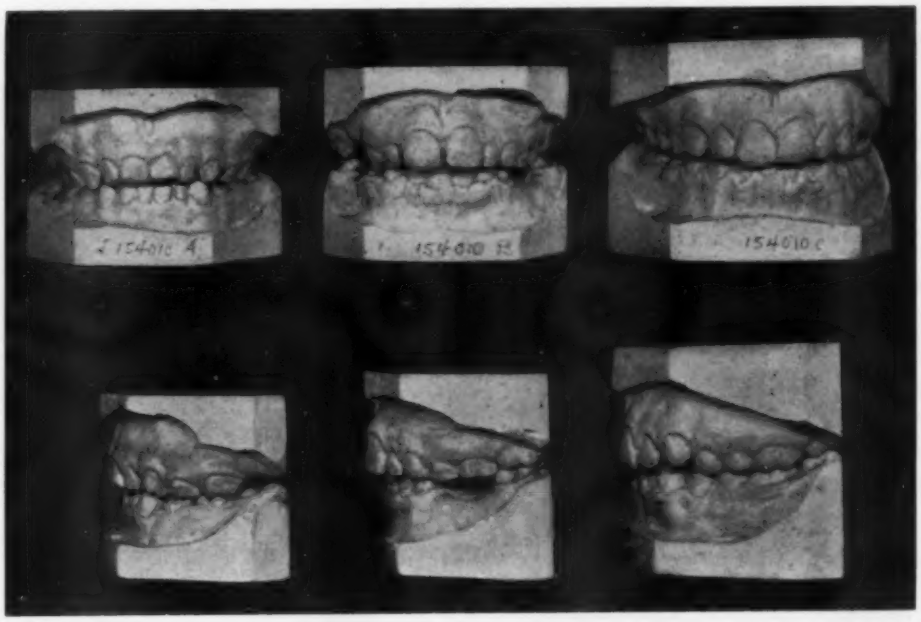


Fig. 30.—Case 154010. Front and side views. Class I case showing a series of models from 5 to 13 years of age which progressively improved without mechanical therapy, resulting in good arch form and good occlusion.

Fig. 31.—Case 213. Front and side views. Typical Class II case showing progress of deformity resulting in a severe malocclusion. Models range in age from 5 years, 5 months to 11 years.

Fig. 32.

Fig. 33.

Fig. 32.—Case 151872. Side view. First model shows minor deviation from normal (slight lingual tendency on maxillary right side), becoming progressively worse and resulting in a typical Class III malocclusion as shown in last model. Models range from 5 to 9 years of age.

Fig. 33.—Front view same case showing the progress of the Class III deformity.

Our Class III cases showed the least likelihood of self-correction of any of the groups.

In this class we had a total of 19 cases for observation. We found that in 17 cases, or 89 per cent, deformities became more severe as time went on. Only two cases, or 11 per cent, remained the same; in other words, these were still Class III cases, but without any additional aggravating factors as far as the occlusion was concerned.

It might be of value here to compare this Class III group (untreated) with the active treatment group at our Forsyth clinic. In the survey of Class III treated cases, a larger percentage of success was found in those cases that were treated early.

Therefore, in view of the fact that Class III cases get progressively worse if left untreated, we should stress very strongly the value of early treatment.

To summarize, what conclusions may we logically draw from the data collected?

Observation should start as early as possible because of the high incidence of malocclusion, and for the sake of the value of information to be gained from studying the direction of growth and development at regular intervals which should be used as a guide to future judgment.

Faulty habits, particularly thumb-sucking, are factors definitely affecting a deviation from normal occlusion and should be discouraged at an early age.

All open-bite tendencies should be observed closely to determine the direction of growth, and certainly Class III open-bite cases indicate that early attempts for correction are requisite.

The importance of space maintenance in the premature loss of deciduous teeth cannot be overstressed in the light of overwhelming evidence that a large number of cases become orthodontic problems because of this factor.

The group classification presents a very important deduction: that a mesial or distal relationship of the arches will have very little chance for improvement without orthodontic aid.

And, finally, we must observe, record, and compare all the general systemic data available, consider the body as a whole, and investigate the hereditary background and the nutritional influence, in order that our judgment may be more mature.

I wish to express my sincere thanks to my associate in this work, Dr. Henry C. Beebe, and to Dr. Fred R. Blumenthal, the director of the orthodontic clinic at the Forsyth Dental Infirmary, for their aid in the preparation of this material.

THE EDGEWISE ARCH MECHANISM AND SOME PRESENT-DAY TRENDS

WILL McLAIN THOMPSON, JR., B.S., D.D.S., PITTSBURGH, PA.

THE edgewise arch appliance was introduced by Dr. Edward H. Angle in 1925. His first published writing was presented in 1928 under the title, "The Latest and Best in Orthodontic Mechanism." A very complete description of this appliance and its auxiliaries, together with the detailed technique associated with its assemblage and use are to be found in these original articles of Dr. Angle. You are all more or less familiar with the appliance so that a description of it would serve no purpose.

It is interesting, however, to note why Angle devised and introduced this appliance when men were doing such excellent work with the ribbon arch. From Angle's writings we learn that to balance all the forces that are brought into play on the teeth we must correct axial inclinations of teeth that are perverted. This was apparently too difficult a mass movement to be accomplished with the ribbon arch which had no positive control over the premolar teeth.

Angle had first written about axial inclination of teeth and the importance of correcting it in an article published in 1913, entitled "Further Steps in the Progress of Orthodontia," as follows: "For a number of years we have been able to classify malocclusion, to note quite accurately the degree of variation of position from the normal of the crown of each tooth, and to judge of its necessary movement in establishing normal occlusion. But heretofore the crowns of the teeth have received our chief attention both in diagnosis and tooth movement, and we have been largely dependent upon nature for the movement of the roots, the positions they will finally occupy being largely problematical due chiefly to the limitations of the orthodontic appliances heretofore at our disposal. But a new era is before us, with far greater possibilities, but with these possibilities come also greater responsibilities as to diagnosis, knowledge of the tissues we operate upon, and technique. We must now study our cases so carefully in the beginning as to enable us to determine accurately not only how great are the variations of position from the normal of the crowns of the teeth, but the extent of the apical displacement and incorrect angle of inclination of each root, and also the extent of arrest in development of the alveolar process and co-related bone, that we may have a clear conception of the exact direction and extent each tooth should be moved and the amount of bone development necessary in order that nature may build the denture to full completion in accordance with the architectural design of the individual type."

Another advantage over the ribbon arch appliance is possessed by the edgewise arch mechanism, namely, its ability to perform more than one type of tooth movement on an individual tooth at one time. With this appliance a tooth may be moved bucally, rotated, and have its axial position changed all at the same

Read before the New York Society of Orthodontists, March 7, 1944.

time. This decreases the time of treatment which is a real factor in orthodontics today and was always an important factor with Angle.

Another factor of increased importance in the edgewise arch appliance was the banding of all the premolar teeth in both jaws. This gave greater anchorage possibilities than any other orthodontic appliance yet devised. The use of the premolar teeth also kept the occlusal plane from being tipped when Class II intermaxillary elastics were worn. This later fact was brought out by Dr. Stallard in 1933.

The fact that Angle went back to the ideal typal arch-wire form at the beginning of treatment with the edgewise arch appliance is also worth noting.

The principle of the ideal arch wire was first introduced into Angle's writings in the third edition of his book, published in 1892, from which I quote: "The wire arch is carefully bent, to conform to the shape of the dental arch, provided the dental arch is correct in form; but if it is contracted, or the teeth occupy irregular positions, no attention is paid to the form of the existing arch, but an ideal arch is formed for the case, or in other words, the wire arch is bent exactly to the form that we wish the teeth to be arranged when the operation is completed."

The principle of the ideal typal arch wire was not used with either the pin and tube or ribbon arch appliances since the arch wires for both of these appliances had to be conformed to the malposed teeth in the beginning of treatment. Thus we see that the paramount points of this appliance were: it could correct perverted axial inclinations of all the teeth; it had increased anchorage units; tooth movements could be accomplished simultaneously and the ideal typal arch form or pattern was established at the beginning of treatment.

The edgewise arch appliance was used by men in the original form outlined by Angle with but two modifications, namely, the introduction of the vertical spring loop by Strang in 1930, and progressive torque force outlined by Brodie.

The results obtained by this appliance were good in part; correct inclined plane adjustments could be accomplished in a very short time and the limitations of the appliance were dictated only by the skill of the operator.

In 1936, Charles H. Tweed of Tucson wrote an article and discussed some radical changes in procedure which caused some concern among Angle's own students. Tweed advocated the distal tipping of teeth in the mandible prior to the application of Class II intermaxillary force in the treatment of Class II cases. In a second part of his paper he advocated the extraction of four premolar teeth in so-called bimaxillary protrusion cases in patients with fully erupted second molars. Needless to say, Dr. Tweed was criticized.

In 1940 he read a paper entitled "The Application of the Principles of the Edgewise Arch in the Treatment of Malocclusion." In this presentation he outlined a procedure of orthodontic therapy based mainly on the concept of placing the lower anterior teeth up over basal bone and keeping them there so as to produced the best balance and harmony in facial lines. When the lower anterior teeth were placed "on the ridge" or directly over what Dr. Salzmann terms "subalveolar" bone, Dr. Tweed found that the stability of the end results of his treatment was markedly increased. If Dr. Tweed could not move the

teeth in the buccal segments of the denture far enough distally, without over-expanding the arches, to allow the lower anterior teeth to be placed over basal bone, then he advocated the extraction of the four first premolar teeth. Dr. Tweed felt that if, in the course of treatment, he could produce nothing better than normal inclined plane relationships of the teeth at the expense of tipping the teeth from the base and marring the facial lines of his patients, he had failed.

Needless to say, the so-called Tweed philosophy or plan of treatment was attacked, but it has withstood all of this.

As a result of Tweed's insisting that the buccal segments of the lower dental arch be moved distally and the anterior teeth tipped lingually, a very loose usage of the term, mesial drift of buccal segments, prevailed in the literature of Tweed's followers. Dr. William Downs of Chicago wrote a splendid article on the subject of "Mesial Drift" and classified it under specific and definite headings.

The term bimaxillary protrusions is now being used in the literature with very little understanding by most orthodontists. Perhaps we can clarify the term bimaxillary protusion by referring to the work of Dr. Calvin Case. Dr. Case apparently was the first to use the term and his own writings on the matter are a bit hazy. Case's use of the term seemed to indicate a normal mesiodistal relationship of the inclined planes of the teeth in a face that showed marked protrusion of the soft tissues of the lips and cheeks—he termed it "dento-facial malocclusion."

In order to better visualize what is meant by teeth "on the ridge" and teeth and faces in bimaxillary protrusion, Figs. 1 to 7 are presented.

Fig. 1.—Here we see plaster models of the right side of a patient, aged 28 years and 2 months, with a dentition in normal inclined plane relationship and the teeth in a vertical axial position.

Fig. 2.—The same model has been sectioned through the central incisors and teeth ground down and placed on the casts to show the relationship of these teeth to the horizontal.

Fig. 3.—Here we see the right side of the casts of a patient aged 12 years, in which the inclined plane relationship of the molar teeth is almost normal, but we note a mesial axial inclination of the incisor teeth.

Fig. 4.—Here we see the child's profile, which is certainly of the protrusive type.

Fig. 5.—The models of this child have been sectioned and the teeth placed to show the perverted axial inclination of the anterior teeth.

Fig. 6.—This slide shows the models of a patient, aged 19 years and 7 months, with a marked bimaxillary protrusion. The inclined planes of the teeth are normal.

Fig. 7.—Here is a profile view of this young lady. Should we call this type, and condemn her to face the world this way, or should we resort to the removal of some teeth and give her some better balance of facial lines and improved psychological uplift as she goes through life?

While this picture of bimaxillary protrusion is clear in our minds, and since we are discussing Angle's last contribution to the specialty of orthodontics, let us see how he felt about extraction of teeth.

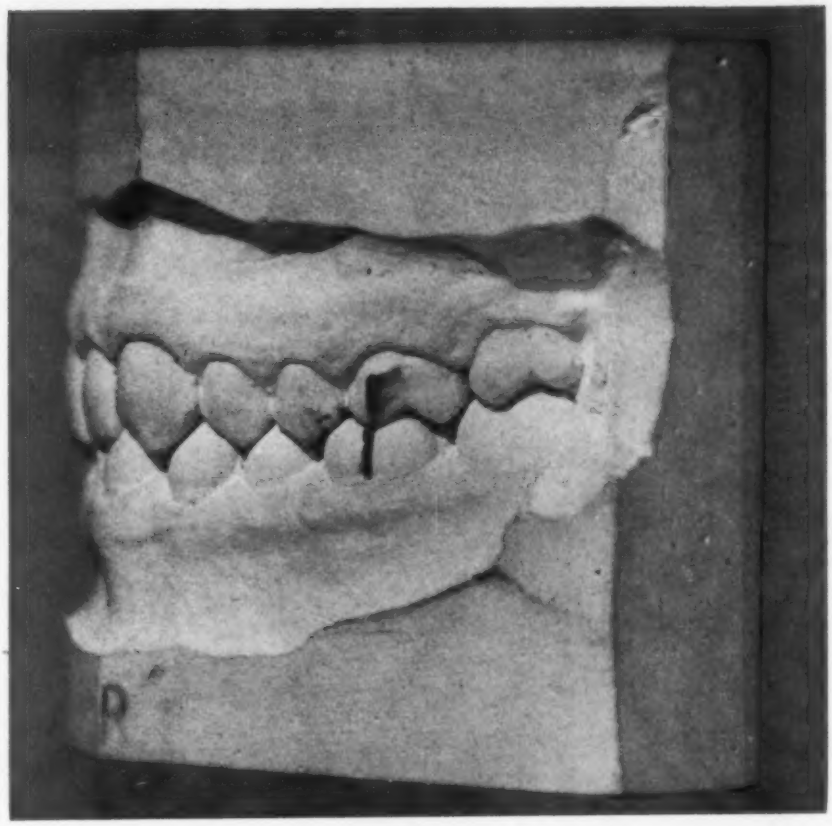


Fig. 1.

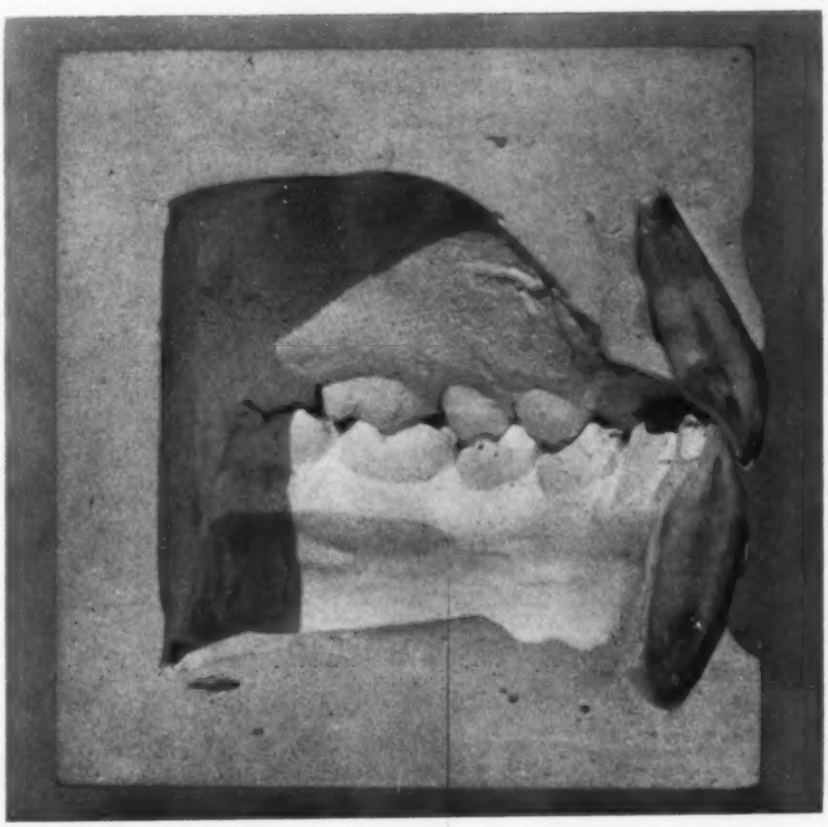


Fig. 2.

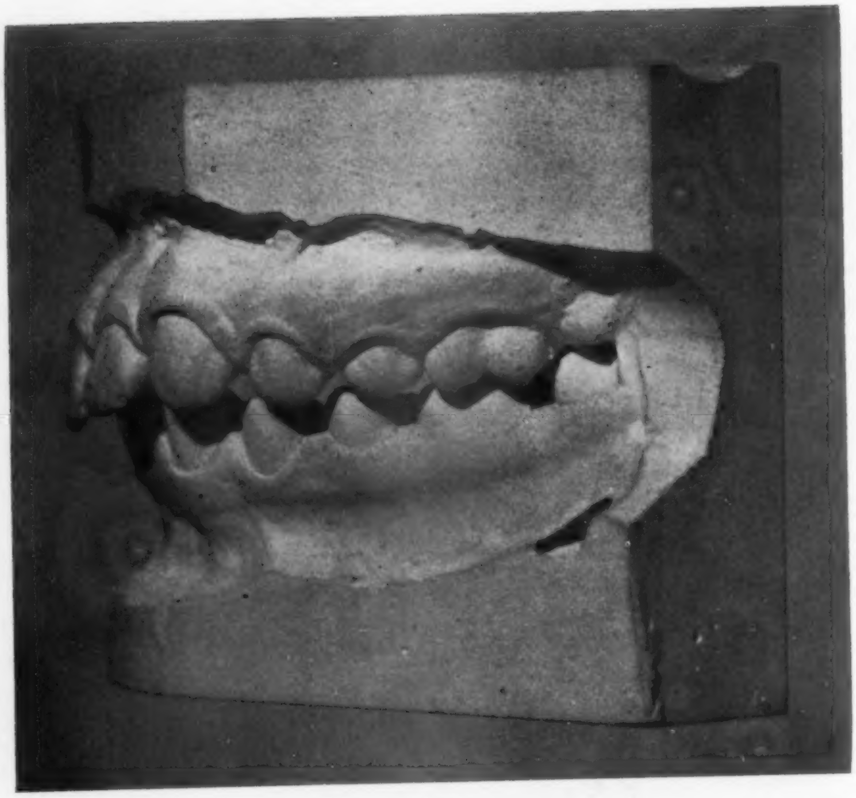


Fig. 3.

Fig. 4.

Seven editions of Angle's textbook, *Malocclusion of the Teeth* were published, the last edition appearing in 1907. In the second through the sixth editions, he shows models in which he resorted to extraction of teeth to correct malocclusion. He does not show any extraction or advocate the need for it in his seventh edition. He strongly opposed extraction from 1907 until his death in 1930.

Any attempt on my part to explain why he opposed extraction after 1907 is purely in the realm of a guess, but it seems from his writings that, with the introduction by Baker of intermaxillary elastic force, he felt that the necessity for extraction was forever eliminated. Angle had the vision of normal occlusion and out of that he built the specialty of orthodontics.

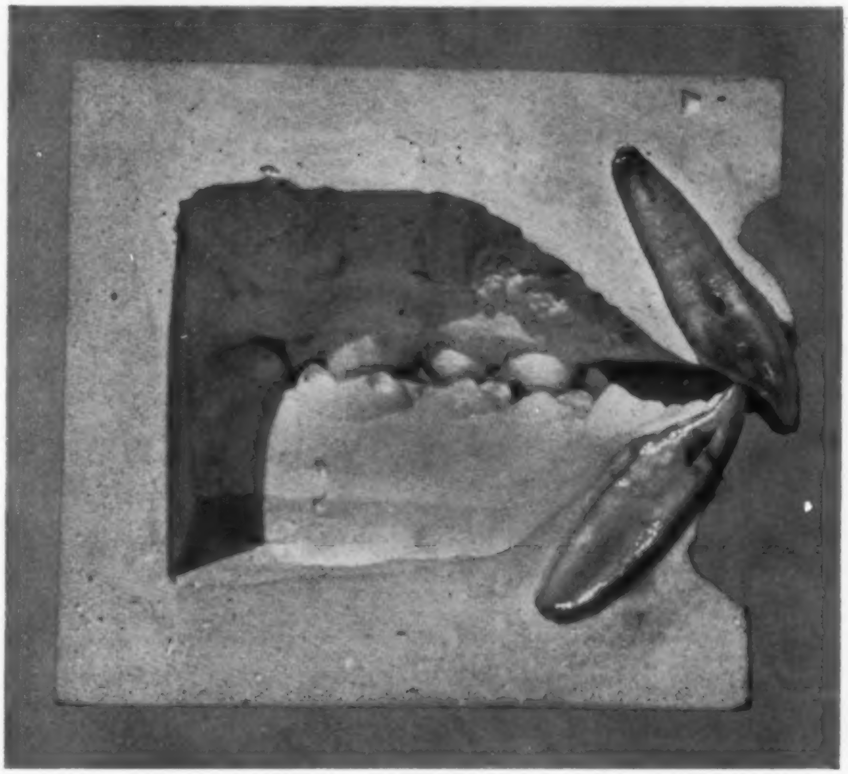


Fig. 5.

Orthodontics has progressed from the scientific standpoint in the last twenty years and one of the greatest steps forward came with the Cephalometer of B. Holly Broadbent. He made two outstanding contributions to our specialty in his article entitled "The Face of the Normal Child" and his recent paper "Ontogenetic Development of Occlusion."

Calvin S. Case and, later, Grieve tried to point out that the reduction of tooth units was necessary if stability in end results of orthodontic treatment and improved facial lines were to be attained in bimaxillary protrusion cases. Many reasons may be given as to why these two pioneers had so few followers. The prevailing idea at that time was that the full complement of thirty-two

teeth was necessary for the best balance and harmony of the face and denture. Neither Case nor Grieve had a definite systematic plan of technical procedure worked out for the average man to master. Another reason for the nonacceptance of extraction in Case's time as well as at present, is the prevalent idea that by placing teeth in normal inclined plane relationship vigorous function of the denture would stimulate jaw growth and the full complement of teeth could be accommodated.

Fig. 6.

Tweed has given us a definite, systematic plan of technical procedure with the edgewise arch appliance that will allow for the treatment of bimaxillary protrusion cases and produce excellent facial lines, with stable and efficient dentures. This can be done with a minimum of tissue destruction in from twelve to fifteen months. Tweed's own results as well as those of his students are proof of the above statement.

Now, let us examine the Tweed philosophy in the light of what the research men have told us. Tweed's contention is that if the teeth in the maxilla and mandible cannot be placed in normal inclined plane relationships without tipping the anterior teeth or pushing the buccal teeth off their bony base, then we had better reduce the number of teeth in each arch and position them over basal bone.

Relative to the growth and development of the bones of the face Brodie has this to say: "To summarize briefly the material thus far covered, it is

possible to state that a longitudinal study of growing children indicated that the morphogenetic pattern of the individual is established at a very early age and that once attained, it does not change."

Krogman, in speaking of Hellman's work, says: "At birth 39 per cent of height, 57 per cent of width, measured against adult size has been achieved. In the first five years 78 per cent of height, 85 per cent of width and 82 per cent of depth have been achieved (these are averages for the sexes). The importance here is not so much an initial inequality and its subsequent reduction, but the fact that after five years of age only 15 per cent to 20 per cent of growth increments remain as avenues of possible readjustment."

Fig. 7.

The late T. Wingate Todd, speaking on this subject, said: "The cause of deficiencies in facial growth is not as a rule to be found in definite clinical disease but rather in long continued poor health or constitutional disturbance for most part subclinical in expression so that the child is not considered by either the physician or parents to be really sick."

It appears that we have for years been attempting to place a normal occlusion or a normal amount of tooth material into the faces of children with subnormal growth patterns.

Speaking of bimaxillary protrusions, let us turn to Broadbent and see what he has to say: "If this process of normal articulation of the crowns of these erupting permanent teeth succeeds in spite of dwarfed facial bones, it creates

in the individual the appearance that the teeth and dental arches are too far forward in relation to the cranial base. This condition is commonly referred to as bimaxillary protrusion. It may be bimaxillary protrusion in the empirical sense, but from the standpoint of these studies of normal developmental growth of the face, it is largely the result of physical handicaps that leave a lasting permanently dwarfed skeletal structure. In other words, the condition and appearance is due more to the retarded facial skeleton than to the dentition being too far forward in relation to the cranial base."

Speaking of the problem of the eruption of the third molar teeth, Broadbent has this to say: "As the normal face completes its progress toward maturity, room for the third permanent molars becomes available and they, like their forerunners in the permanent molar series, 'wiggle' their way toward the occlusal plane cutting into the oral cavity to complete the permanent dentition. About the time that the crowns of the last permanent molars are complete (around the fourteenth year) the handicaps suffered by an individual who has been thwarted in nature's plan to achieve full development of the skeletal structures deny the third molars their scheduled eruption. This failure of the face to provide enough room for the teeth is likewise apparent in the anterior segment of the dental arches for it prevents the incisors, particularly the lowers, from maintaining their normal position in the line of occlusion. Any buckling of the lower dental arch is commonly attributed to the so-called pressure of the erupting third molars. Factual evidence collected by the Bolton Study for the past twelve years would acquit the wisdom teeth of the aforementioned charges and include them along with the incisors as cosufferers resulting from the failure of the facial skeleton to attain its complete adult size and proportions."

In the light of these few statements relative to the problem we face as clinical orthodontists, it seems that the research men indicate the procedure of extracting teeth is a proper rather than a radical procedure. Caution and time will show us the best plan.

I believe a few remarks relative to the best time to institute orthodontic therapy would not be amiss at this time.

Since the turn of the century, the problem of the correction of malocclusion at a very early age, as opposed to waiting for the proper time to place orthodontic appliance, has taken up a great deal of space in the literature.

Some men felt that, by placing appliances and stimulating the growth of the mandible and maxilla, the necessity for later treatment would be overcome.

Once again let us turn to the research men and see what their findings are.

Hellman's studies on this problem are outstanding. He feels that the maximum growth period would be a good criterion to go by. In one of his many papers on this subject, he tells us that in males with normal occlusion this maximum growth period appears at a chronological age of 12 to 16 years; in females it is from 8 years to 10 years and 3 months.

Recently Hellman writes: "Thus boys with dentitions in malocclusion take, on the average, approximately one year and a quarter, and girls one year and a half longer to get their permanent teeth than do those with normal occlusion."

Some men feel that cases should be treated in the deciduous or early mixed dentitions. Samuel J. Lewis and Lehman in their work at the Merril Palmer

School found things out which make them feel that early treatment must be approached very thoughtfully. I quote: "But it is evident that other growth factors besides wide spacing are of the utmost importance in determining the alignment of the permanent incisors. Hence, in diagnosis, observation over a period of time would seem to be a more satisfactory method of determining whether mechanical appliances should be used. Certainly it would do no harm to watch and wait for a time in all cases. The alignment may improve during the period of observation, which may vary from a few months to a year or two, and if it does not improve, orthodontic treatment may still be instituted with successful results."

Broadbent says: "If any one period in the development of occlusion is more complicated than another, it is the period of mixed dentition."

Brodie's cephalometric appraisal of their work at Illinois is partially summarized when he says: "Actual bone changes accompanying orthodontic management seems to be restricted to the alveolar process."

Thus it is seen once again that we, as clinical orthodontists, can gain much from a study of what the research men find.

It would appear then that the average child should not be subjected to long-drawn-out periods of orthodontic treatment except in Class III cases and extreme Class II cases.

There is a time for each individual case that will allow us to produce the best orthodontic result for that individual, and we should always be on the alert so that we may recognize it.

In an editorial appearing in the October, 1943, issue of the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY entitled "At the Crossroads," Dr. Milo Hellman poses some questions which should be given much serious thought by all orthodontists and more particularly those using the edgewise arch appliance. Perhaps other men embracing the Tweed philosophy will feel able to answer these questions. I have asked myself some of the same questions in the past seven years and most of the answers are still missing.

The mass of clinical evidence being piled up by those men who attempt to use the Tweed plan of treatment is beginning to gather weight.

Hellman says, "Reliability in achievement, therefore, depends upon proof that the proportion of successes is greater than that of failures."

A little later Hellman states: "What stands out clearly is that there is no unanimity in the understanding of what constitutes a success or a failure."

In answer to Dr. Hellman's first question it would seem that Tweed and others employing the edgewise arch mechanism have shown publicly a larger number of treated cases that surpass any others treated with other appliances. This does not mean that excellent orthodontics is not being done by other men with other appliances, but, by and large, they have not shown a series of treated cases that come up to the standard of Tweed.

Here again the standard of appraisal of a successfully treated case becomes a pertinent point.

In a paper published in 1920, Dr. Hellman said: "Occlusion in my opinion is the final testimony as to the success or failure of orthodontic treatment."

In another paper published in 1920, Hellman has this to say: "It may likewise be said that an accumulation of observations, a collection of appliances,

a manifold manner of their manipulation and a variety of results do not constitute a profession. A practical purpose, enhanced by a uniform educational system, with a general aim and a common interest and an exchange for ideas, are the requisite fundamentals for the construction of a professional background.''

How true every bit of this statement is—never before have we needed to set up some clearly defined standards as we need to today.

Orthodontics, I feel, has been ''at the crossroads'' before, since the turn of the century, and managed to work itself out. Sometimes it was because of technical issues, other times theoretical problems shook it to its very foundations, but it has always seemed to right itself and survive.

I think all of us should accept Dr. Hellman's editorial as a challenge. Here is a man who has made some of the outstanding contributions to our specialty, and now after watching carefully over this field of endeavor for almost forty years, he sees some dark foreboding clouds gathering on the horizon.

Let us examine our position from time to time and strive toward a more uniform approach to the orthodontic problem.

Much that was considered law twenty years ago has been proved false; it goes without saying that our present-day concepts will probably be altered in the future.

The research men have contributed a tremendous amount of material to orthodontics in the last twenty years. Some of their findings have definitely established the truth of certain things which were questionable in the light of clinical findings; on the other hand, they have shown some things to be false which in the past were thought to be true.

The clinical orthodontists, striving to improve and perfect the technical portion of our specialty, have also contributed a great deal. Sometimes the research men appear to belittle the clinical findings of the men who do not approach the problem in a scientific manner. Likewise, much valuable research work is not given its proper appraisal and application by the clinical orthodontist.

It is hoped that in the future a better working relationship may be effected between these two groups so that the best orthodontics will be practiced for the children who come seeking our aid.

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ADAPTING THE JOHNSON PROCEDURE TO THE PLAIN LABIAL APPLIANCE IN CERTAIN CLASS II, DIVISION 1 CASES

WALTER R. BEDELL, D.D.S., POUGHKEEPSIE, N. Y.

THERE is an ancient idiom to the effect that complexity breeds complexity and at no time has this been more apparent than in the world of today. Having been reared under the tutelage of Dr. Mershon, simplicity of appliance was of primary importance, and it is with growing concern that I watch the continual increase in the over-all magnitude of some of the more recent complicated appliances. It is unfortunate that in stage and movie conversations they are referred to as anything from bits to harness. Is it not better to *urge* Nature in the right direction, perhaps a little insistently, rather than to bludgeon her into compliance? Perhaps we are unconsciously absorbing some of the prevailing atmosphere of dictatorship, which, as always, and especially where Nature is concerned, will bring us nothing but sorrow. In our enthusiasm to make every tooth behave just as the doctor ordered, let us not lose sight of the wonderful improvements that can be accomplished with simplicity and dispatch by giving attention to the architecture of the bones and muscles involved, as well as a few simple laws of directional stresses and strains. With this in mind, it is possible to establish good functional occlusion and begin the elimination of soft tissue deformity, while some of the more ingenious devices are still in the making.

For those who possibly are not familiar with the Johnson technique let me restate briefly a part of the procedure which he advocates with this revolutionary appliance. The phase which is to be discussed in this report is that of primarily retracting the maxillary anterior teeth in the treatment of so-called Class II, Division 1 cases according to Angle. The slides used to illustrate the different points are selected from various cases in my practice in which photographs of each step are routine procedure.

As originally described by Dr. Johnson and more recently by Dr. Howes in papers read before this society, this procedure is accomplished by intermaxillary elastic force, pitting mandibular anchorage against only four or perhaps six maxillary anterior teeth. Due to the flexibility of the anterior section of this appliance it is possible for the end sections to slide freely through the molar buccal tubes although converging mesially.

The result of this first step in the correction of these cases is the "jamming up" of the canines and premolars and the earlier and more opportune engagement of the upper and lower incisors to assist in the stabilization of the mandibular anchorage while the maxillary posterior teeth are being moved distally and buccally in the cancellous bone.

This latter step is accomplished by the use of coil spring force applied to the mesial ends of the buccal tubes plus the eruptive or re-eruptive urge

Read before the New York Society of Orthodontists, March 6, 1944.

of the crowded canines and premolars. The success or failure of the treatment is dependent entirely upon the continual and incessant wearing of the intermaxillary elastics unless sliding maxillary hooks are used.

Permit me to pause here momentarily and pay tribute to Dr. Stanton, whose system of maps over twenty years ago disclosed the frequent necessity of moving posterior teeth distally to establish normal occlusion.

As the Johnson twin-arch appliance has no power to stimulate lateral expansion, it must be used in conjunction with a lingual arch. This is, of course, necessary in the cases under discussion as the buccal segments must diverge slightly while moving distally in the channels of cancellous bone as described by Dr. Atkinson.

In adapting the afore-described strategy of treatment to the plain labial appliance, it also seemed at first necessary to employ a lingual arch to accomplish the necessary expansion and stabilize the molar anchorage. More recently, however, in cases with fairly symmetrical maxillary arches, suffering primarily from forward displacement of either a protrusive or protractive nature, I have found that with a judicial placement of the intermaxillary hooks and the use of only 3 ounces or less of intermaxillary force, as measured on the Johnson or any other scale, it is completely feasible and advantageous to dispense with the lingual arch and employ only extension arms or yokes from the molar bands. For this purpose I use a slightly softer but very tough 0.038 inch wire which, having a free end, may be safely and readily adapted to erupting canines and premolars with a No. 208 Bisco plier.

As to the construction of the labial arch, it may be either precious metal or chrome alloy spring temper 0.036 inch round wire fitting into round ¼ inch buccal tubes. These tubes must be parallel or nearly so in all planes to permit the labial arch to slide distally as the anterior teeth are retracted. However, if the molars are rotated and the arch is extremely narrow in the canine and premolar area as is so often the case, the tubes may be placed so as to converge somewhat mesially and the arch is then bent to correct these conditions, bringing the tubes into parallel as the desired rotation takes place.

The lock is a simple rectangular one, of 0.020 inch round spring temper wire which I have been using with great success and very rare displacement for nearly twenty years. It merely hooks under the arch wire distal to the buccal tube where the tube extends away from the band. This is essential as otherwise it will bind between the arch wire and the band and prevent its proper functioning. At no time must there be any retractive force in this lock, except in those rare cases of distal displacement of the molars or where extractions have been necessary.

I consider the positioning of the upper intermaxillary hooks and the delicacy of the elastic force used to be of the utmost importance both in the matter of stabilization of both the maxillary and mandibular anchorage and the maintenance of the anterior section of the labial arch in its proper relationship to the maxillary anterior teeth both in their original protrusively tipped position and also their corrected and more vertical placement.

Since the labial arch is not being stopped in the molar region when the incisor teeth are being tipped lingually, the arch naturally tends to slide

gingivally. This is the most difficult mechanical hazard of the entire treatment with which to contend. For the first few weeks I often order the elastics to be worn only in the daytime, because it is during the night, while the jaws are at rest, that the arch is most apt to creep gingivally.

Fig. 1.—Showing expansion of narrow arch with converging buccal tubes brought into parallel for retraction of incisors, construction of molar lock, and ligatures looped incisally over cingula instead of old incisal hooks.

Should even this procedure prove ineffective, as a last resort I stabilize the arch by attaching it to the anterior teeth. At one time I used incisal hooks, but I now employ ligatures looped incisally over the cingula on the lingual surfaces. You will note the intrusion of the two central incisors where this has been done. Although I dislike any definite attachments to anterior teeth, this does at least tend to restore the curve of Spee and not the reverse, as so often occurs in stabilizations of this nature. (Fig. 1.)*

*Most of the illustrations used were made from Kodachrome transparencies at considerable loss of detail.

So much for this early and more difficult part of the treatment. As the anterior teeth retrude and the arch wire extends through the distal ends of the buccal tubes, the ends may be cut off slightly and the locks taken up just enough to prevent any side slipping of the appliance, always remembering that they will have to be opened again as the molars are later moved distally. With the completed retraction of the upper anterior teeth until they engage the lower incisors, preferably still in a relationship of fairly deep overbite, and the resultant jamming up of the maxillary canines and premolars, the arch wire is now expanded 4 mm. at the distal ends; then each end is bent back lingually 1 mm. by grasping the arch wire with the pliers just anterior to where it issues from the mesial end of the buccal tube. This results in a 2 mm. buccal expansion of the buccal segments as they travel distally.

Coil springs are added between the attachment of the lock wires and the mesial ends of the buccal tubes. The lock wires are opened 2 mm. and readapted to the arch wire, which automatically permits the anterior section of the arch wire to stand 2 mm. away from the maxillary incisors. Note the compression of the coil spring when the elastic is added. It is also highly important at this stage that there be a balance between the elastic force and the coil springs which transmit this force to the molars. This balance should permit the elastic force to compress the coils just enough to bring the anterior section of the labial arch back against the maxillary incisors to retain them in their retruded position. The locks will of course stand 2 mm. away from the distal ends of the tubes. At each succeeding appointment the arch is removed by simply unhooking the lock wire, the coil springs are stretched slightly, and the locks are opened a little to compensate for the distal movement of the molars since the last appointment. The buccal segments may also be expanded slightly by the simple procedure as previously outlined.

Part of the anterior ends of the lingual yokes may now be cut off and the remaining ends bent around the lingual cusps of the first premolars to guide them distally as they erupt or re-erupt.

When distal movement of the molars has been completed, I purposely make the coil pressure greater than the elastic force, to permit a slight distal tip of the molars as in the normal curve of Spee and to establish a toeing-in against relapse as originally suggested in Dr. Tweed's technique of secondary bends for mandibular anchorage. Note the settling of the teeth into occlusion. (Fig. 2.)

At the conclusion of this stage of the treatment and the establishment of normal anteroposterior relationship, should there be any anterior rotations necessary, it is a simple matter to band these teeth and substitute for the labial arch the Johnson twin-wire arch which fits into the 0.036 inch round buccal tubes. This permits a minimum period for the wearing of maxillary anterior bands which many of my patients abhor, and with which attitude I must agree. However, the 3/32 inch Johnson incisal bands, permissible and practical because of the great delicacy and resiliency of the controlled forces of this appliance, are much less objectionable.

You will note that at no time have I mentioned what shall constitute the molar anchorage, and I have no intention of entering into this controversial

subject now. However, I will say that whereas there are many cases in which more mandibular anchorage is needed than just a simple Mershon lingual arch, nevertheless I sincerely believe that a major part of the trouble reported is due to too violent an intermaxillary force being exerted. Referred cases come into my office wearing intermaxillary elastics exerting a force of 6 ounces or nearly half a pound. Naturally the entire mandibular alveolar process slides anteriorly and the condyle also tends in that direction, with resultant crowding of the mandibular incisors and later relapse of the anteroposterior relationship, when this extreme force is removed and the muscles which control the condyle reassert themselves.

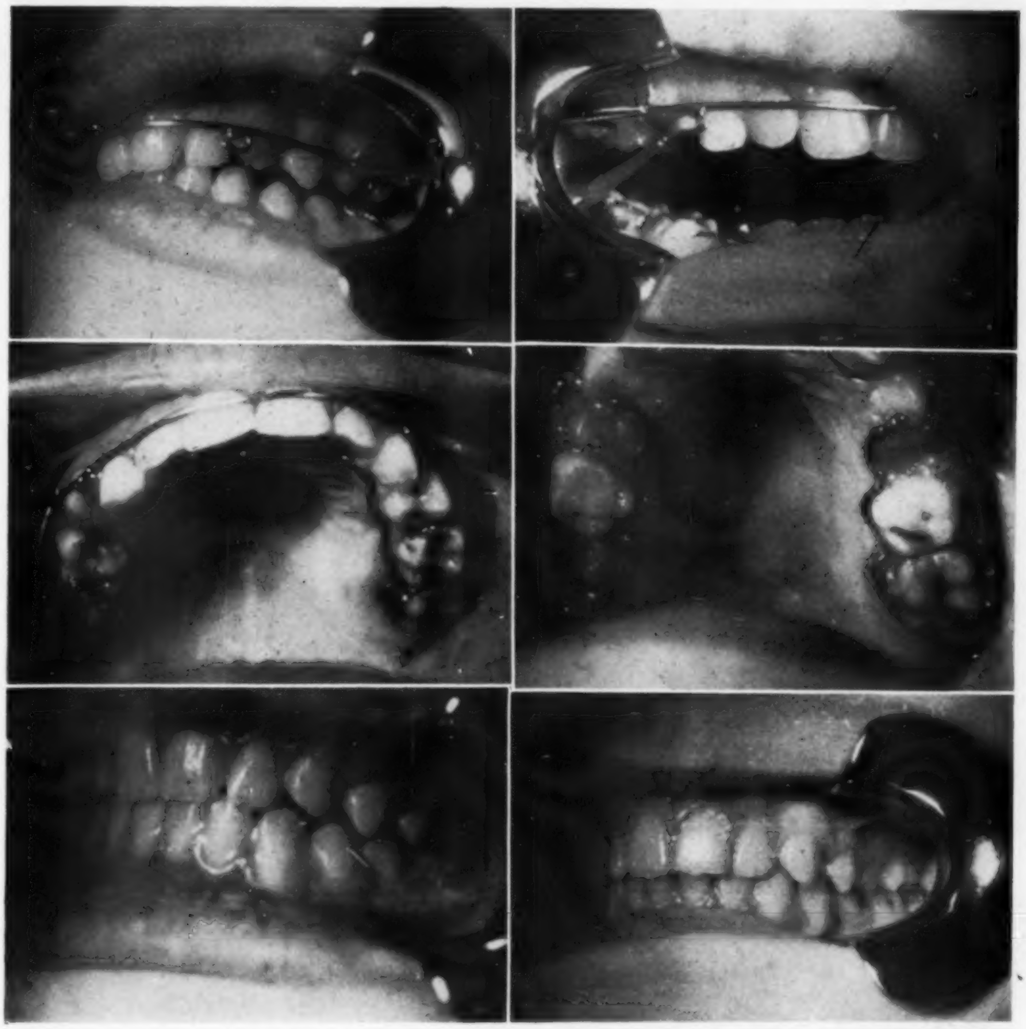

Fig. 2.—Showing "jamming up" of canines and premolars, addition of coil springs to begin the distal movement of the molars, lingual yokes adapted for distal movement of buccal segments, and the teeth settling into occlusion.

Although preferring to treat from $10\frac{1}{2}$ years to 12 years, if there is a marked soft tissue deformity, as often exists in these cases, I frequently treat at earlier ages. This procedure eliminates or reduces the buccal displacement of the second molars as they erupt. Also, as Dr. Hellman has pointed

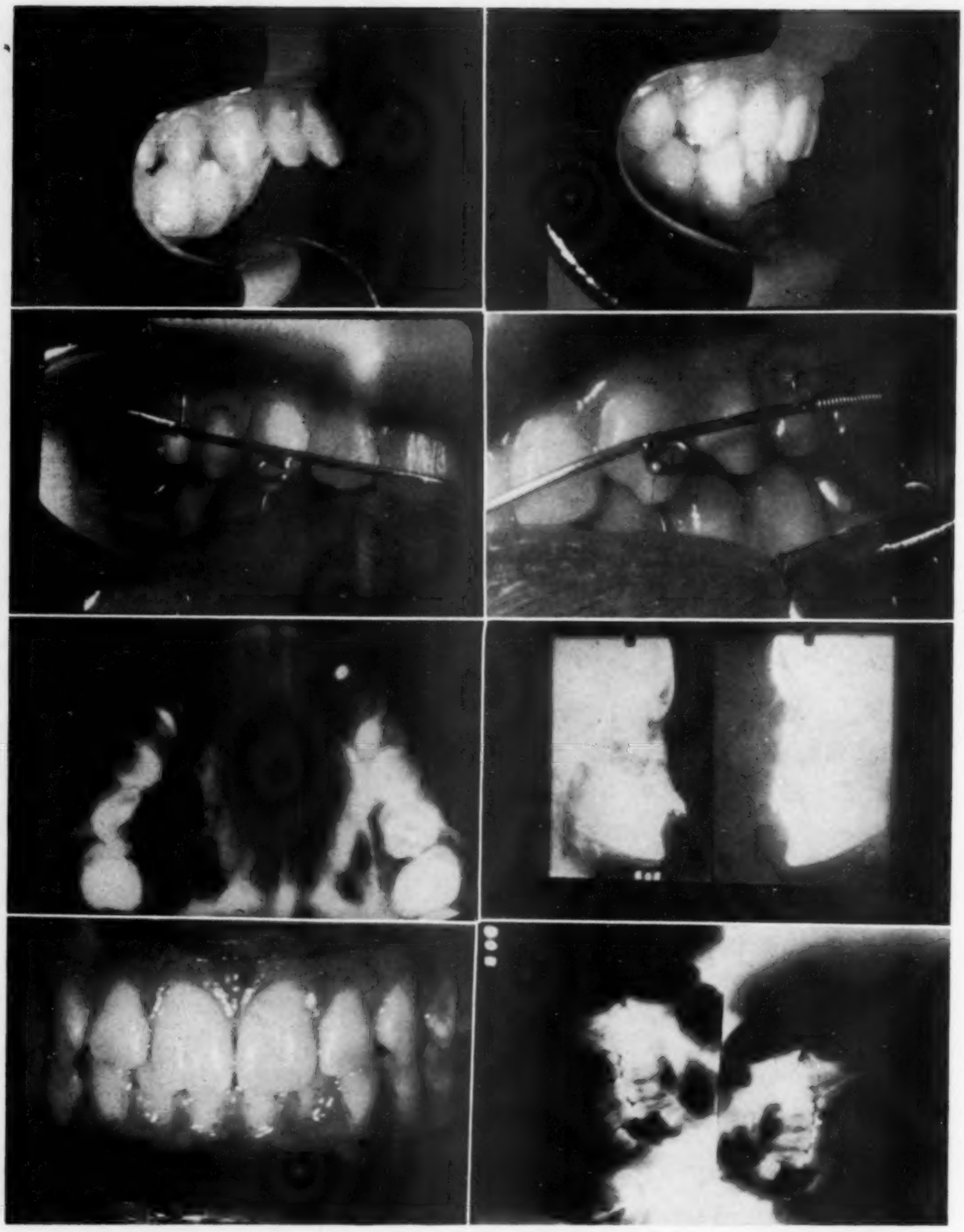

Fig. 3.—Showing profile oral before treatment and after retraction of incisors, distal movement of buccal segments after placing coil springs, occlusal x-ray showing corrected relation of maxillary first permanent molars to key ridge, profile before and after treatment with no apparent increase in axial inclination or forward displacement of mandibular incisors, full face oral aftertreatment, and third molars erupting normally.

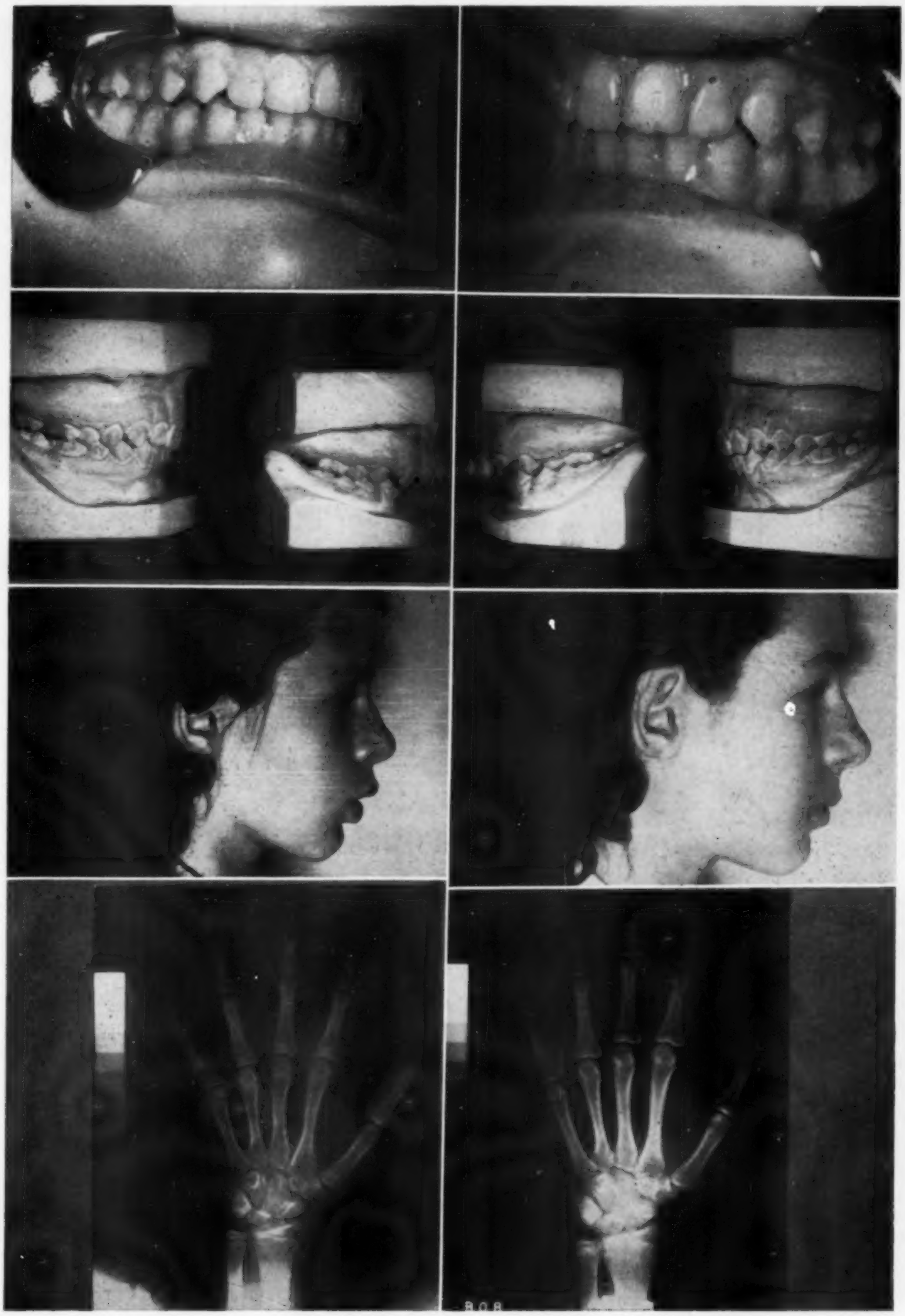

Fig. 4.—Showing right and left oral showing final relation of buccal segments in centric occlusion, models before and after treatment, profile before and after treatment showing marked improvement in facial line and soft tissue deformity, and hand maturation disclosing over six months retardation at start of treatment and normal development four months after completion of treatment, according to Todd.

out in one of his thorough researches, the rest period in Class II, Division 1 cases, is from 8 years and 4 months to eleven years in males, and from 7 years and 9 months to 10 years in females. Thus, to wait until after the second stage of eruption may require postponing treatment until 12 or 13 years of age, with the complete establishment of soft tissue deformities. I believe this recent tendency to delay treatment to shorten its duration, with the resultant soft tissue maldevelopment, has effected stabilization of results detrimentally, thereby encouraging the increasingly prevailing trend to extractions.

Please note how nicely the bite opens during this treatment of these cases. Can there be any doubt that this is at least partly due to vertical development in the molar areas, since the forces are all applied in those areas and none in the incisor region except during the very first part of the treatment. This also eliminates the necessity of bulky bite planes on upper retainers and the resulting trauma of the mandibular incisors and permits unimpeded excursion of the mandible during mastication. However, there can rarely be maintenance of more than 3 mm. of this vertical development, as this is the average separation of the molars when the muscles are relaxed, and it is all they will tolerate.

I now propose to run quickly through the slides of a case which was treated by this method. In these cases the active treatment requires no more than nine or ten months, which means that despite the amount of preliminary data which I routinely require, the elapsed time from first appointment to the placing of the retaining devices as a rule, is, under one year in cases treated at 11 years of age or older.

The case presented is that of a girl, aged 11 years and 3 months, having nothing unusual in her history except an eye condition which had necessitated four operations, the last just before treatment was started. (Figs. 3 and 4.)

CONCLUSION

The sum of this treatment is merely to adapt the Johnson procedure to an old appliance to move certain teeth in all three planes of space and gain the desired end result without shackling the teeth, establishing a different sort of "New Deal," with individual freedom instead of regimentation. It is an appliance which is simple to make and operate, causes no pain when placed nor injury to roots when operated, and accomplishes the desired results with a minimum of bands. It also permits of some neglect in the wearing of the elastics, which we all have encountered, as the coil springs merely push the arch wire away from the incisors making the appliance less comfortable. I recommend it to you for your consideration.

49 Market Street

A METHOD OF REPLACING MISSING ANTERIOR TEETH ON LINGUAL ARCH, USING ACRYLIC RESIN

DONALD A. CLOSSON, D.D.S.,* KANSAS CITY, MO.

FREQUENTLY it is necessary to replace a missing lateral incisor or occasionally a central incisor which has been lost by accident in persons ranging from 8 to 15 years of age, when the patient is too young for any type of fixed or removable bridgework.

In the past, various means have been used to replace these lost teeth, such as a simple band and loop space maintainer, vulcanite or acrylic palate with denture tooth attached, lingual arch with soldered backing and facing or Steele's backing and facing, or orthodontic bridge, using orthodontic bands on abutment teeth.

In this method of replacing an anterior tooth, a lingual arch is made in the usual manner, either a fixed lingual, or a removable lingual using half-round tubes and shafting. Due to the age of the patient, the fixed lingual is probably more desirable to reduce the possibility of breakage. After the molar bands have been made and the impression taken, wax is then placed on the lingual side of the molar bands to facilitate soldering. The work cast is poured in stone for it is necessary to wax the pontic to a lug on the arch as a means of attaching the acrylic tooth. (Fig. 1.)

Fig. 1.

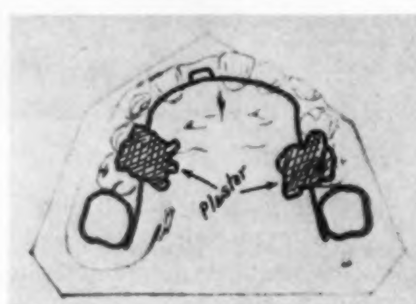

Fig. 2.

Fig. 1.—Showing lug soldered to arch wire for upper right central pontic. Note wax on lingual of molar bands prior to pouring wax.

Fig. 2.—Showing plaster splint holding arch wire in place for soldering ends of the wire to the molar bands.

The attached lug should be of 0.030 inch wire, which will give the necessary strength to hold the acrylic facing, and is placed on the arch before soldering arch wire to molar bands. The reason for attaching the lug prior to soldering is to avoid disintegrating the stone cast in the area of the missing tooth. A small plaster splint is used to maintain the arch wire in the correct position while soldering to the molar bands. (Fig. 2.)

*Assistant Director of the Orthodontic Department, The University of Kansas City, School of Dentistry, Kansas City, Mo.

Presented as a Clinic at the Annual Meeting of the Southwestern Society of Orthodontists, March 1, 1944.

The arch wire is then soldered to the molar bands. There are two different methods which may be used to form the pontic. The first method described is in most cases more practical because of its simplicity. Select an acrylic tooth of the proper shade and contour. The tooth should be cut away on the lingual side in order to have the correct relation to the lug. (Fig. 3.)

Any trimming necessary to adapt the tooth to the space should be done at this time. The facing is then waxed to the lug, being careful to adapt wax over the saddle area beneath the lug. The arch with pontic attached is then invested and the acrylic is packed into the mold after the wax has been eliminated, thus uniting the facing to the arch wire.

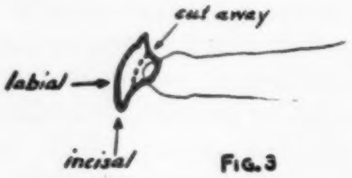

Fig. 3.—Showing cross section of facing in relation to arch.

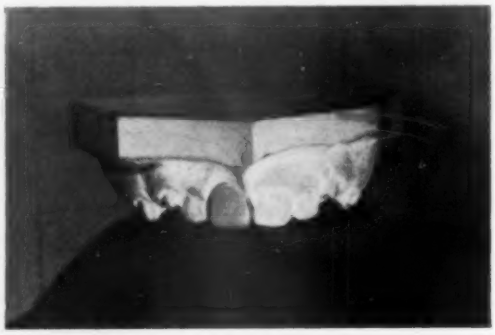

Fig. 4.—Labial view of finished pontic.

The second method of forming the pontic is to carve entirely of wax the tooth to be replaced. Consideration must be given to the proper relation of the wax to the lug, gingival tissue, and occlusion.

The arch wire with pontic attached is then invested and the incisal and gingival shades of the acrylic resin are packed in the mold. The principal objection to this method is the difficulty of carving, investing, and obtaining the desired shade of the tooth to be replaced.

The advantages of using acrylic resin to replace these missing teeth are that it is more esthetic, there is less breakage, it is more sanitary, and there is better function.

1108 EAST TENTH STREET

REPORT OF THE COMMITTEE ON NECROLOGY

The Committee on Necrology of the American Association of Orthodontists deeply regrets to announce the passing of fourteen of our loyal members during the last two years. They are as follows:

Dr. Harry A. Allshouse, Jr.	Kansas City, Missouri
Dr. Varney E. Barnes	Cleveland, Ohio
Dr. Willard N. Brown	Fargo, North Dakota
Dr. Charles W. Bruner	Waterloo, Iowa
Dr. Max J. Futterman	New York, New York
Dr. Frederick E. Haberle	Chicago, Illinois
Dr. Warren D. Haggerty	Hackensack, New Jersey
Dr. Addison Kingsbury	Columbus, Ohio
Dr. Oren H. McCarty	Tulsa, Oklahoma
Dr. Ernest M. Setzer	Oakland, California
Dr. J. B. Stevens	Newark, New Jersey
Dr. J. H. Winstanley	Wenatchee, Washington
Dr. Leslie P. Abbe (retired member)	Hartford, Connecticut
Dr. Louis H. Mann (retired member)	Asheville, North Carolina
Lieut. Col. B. I. Newsom (Service member)	Washington, D. C.

As a fitting tribute to these members, the committee respectfully submits the following resolution for your consideration:

WHEREAS, an all-merciful and all-loving Father has called from our fellowship the above-named members, be it therefore

RESOLVED, that in recognition of their valuable services to humanity, this association desires to record its appreciation of their work, its acknowledgment of esteem and affection in which they were held and to express the heartfelt sympathy of members of this Association with the bereaved family in a mutual and irreparable loss; and be it further

RESOLVED, that a copy of these resolutions be spread upon the minutes of the association as a permanent memorial, and a copy be sent to the bereaved families.

Respectfully submitted,

W. T. Chapman, Chairman
A. B. Thompson
E. W. Swinehart

REPORT OF THE AMERICAN BOARD OF ORTHODONTICS

In a patriotic and cooperative spirit, the American Association of Orthodontists followed the general authorized suggestion to all organizations that, wherein possible, no conventions should be held in 1943.

In conformity with this action, the Directors of the American Board of Orthodontics joined in this spirit and decided unanimously to postpone its 1943 meeting. The directors have accordingly held their offices over until this year. They considered that the business before the Board was not of sufficient urgency to warrant a meeting, especially since the parent organization had taken similiar action.

At this time the Board wishes to express its appreciation for the fine spirit of cooperation and support given it by the American Association of Orthodontists. Only in this spirit can the goal of a higher level in orthodontic practice be attained and the existence of our organizations justified.

We are hoping that the orthodontic profession as a whole will become more familiar with the purpose of certification, its increasing value from the standpoint of personal satisfaction, and the growing inspiration it engenders towards the attainment of higher standards in orthodontics.

At the meeting of the Board just adjourned, thirty-one applications were received, the largest number received at any meeting in the history of the Board. In view of the fact that many orthodontists are in the services of the Army and the Navy, the added number of applications received this year is evidence of an increasing interest in the work of the Board, all of which is most gratifying.

In order to be helpful to applicants in the preparation of their material, the Board has seen fit to offer suggestions of outlines to be followed in the preparation of case reports, exhibits, and theses. The use of certain nomenclature, though not mandatory, has been suggested, to the end that clarity and uniformity in the presentation of material will be aided and confusion avoided. Year by year a gradual improvement in the standard of presenting the material of applicants has been observed by the Directors. These suggestions, if adopted in some manner as a basis of regular office routine, will prove of value as a ready reference in the preparation of case reports and other material and will enrich the literature of orthodontics.

The records of the American Board of Orthodontics from its inception to the present time have been carefully examined since its 1942 meeting. At the recent session of the Board a new Constitution and a revision of the By-Laws were adopted, into which have been written amendments which had been adopted from time to time as well as other harmonizing features. The rules governing the operation of the Board were also revised to facilitate this operation.

The question has arisen on many occasions as to the method of application for certification, and some clarification on this point seems indicated. Anyone interested should apply to the Secretary, who, in turn, will furnish full instructions. After an application blank is filled out by the applicant and returned to the Secretary, it will be considered at the following meeting of the Board.

Unless an application has been properly filled out which supplies all required information, it cannot be accepted. In such instances, the applicant is notified that additional information must be supplied before his application can be further considered.

After an application has been accepted, the requirements for examination are stipulated and the applicant is notified. At the next meeting of the Board the material which he has supplied is examined by the Board and the applicant is notified of the results. In each instance the applicant has a year in which to prepare the material for presentation to the

Read before the American Association of Orthodontists, Chicago, Ill., April 25 to 27, 1944.

Board. Should circumstances make it impossible for the applicant to prepare his material in one year, an additional year is granted and if the requirements are unable to be met by this time, he is granted one final year to present his material to the Board.

The Albert H. Ketcham Memorial Award is made jointly by the American Association of Orthodontists and the American Board of Orthodontics. A committee of five is authorized to select the recipient of the Award and is composed of the President, Vice-President and the President-Elect of the American Association of Orthodontists, and two Directors of the American Board.

Dr. B. Holly Broadbent of Cleveland, Ohio, has been selected the recipient of the Award for this year, on the basis of his extensive investigations and study of the developmental growth of the face in growing children.

As you might know, it is the natural desire of the American Board of Orthodontics that the profession should be ever mindful of the devotion and spirit of Albert H. Ketcham and his tireless efforts to elevate our specialty to loftier heights. He so lived that he might deliver to his clientele the best and most scientific service attainable. He was painstaking and thorough, ever thinking, studying, and applying his knowledge. Yes, he was a potent force in orthodontics. The success of his accomplishments was the result of an orderly way of living and doing things. To all who knew him it is readily understandable how one with such a professional background would naturally be interested in the founding of the American Board of Orthodontics.

It is no small honor to have had a part in helping to stimulate the orthodontic profession through certification, the presentation of the Ketcham Award, and otherwise to promote a fuller appreciation of orthodontic problems and the desire for a deeper and a more thorough habit of thinking, studying, and applying.

The Directors of the American Board of Orthodontics deeply appreciate this privilege of serving the orthodontic profession, though at the same time they recognize in it a definite responsibility.

Respectfully submitted,

W. E. Flesher, President

PRESENTATION OF THE MARTIN DEWEY AWARD

Dr. Paul Spencer.—President Burrill, members of the American Association of Orthodontists, and guests: Since this is the occasion of the first presentation of the Martin Dewey Award, it is apropos to mention briefly the details of the establishing of this award.

Following the death of Dr. Dewey, the annual or periodic meetings of the Dewey Alumni Association were discontinued. There remained in the treasury a sum slightly in excess of $900. A portion of this has been placed in a trust fund, under the direction and control of the Board of Directors of this Association. The annual income from this trust fund will provide ample revenue for an appropriate certificate, signed by the officers of this Association, to be awarded to the clinician presenting the most outstanding clinic at each annual meeting.

It should be mentioned that while the officers and Board of Directors supervise the management and control the awarding of the certificate, it is definitely stipulated that the Association shall not be obligated to incur any expense at any time. However, since the estimated income appears to be more than ample to provide and prepare the annual certificate, it is stipulated that any excess revenue will, from time to time, as the Board may determine, be placed into and become part of the general fund of this Association.

It is the hope that this award will serve a twofold purpose: it will tend to give annually some recognition to the clinician presenting something of practical value to us at our meeting. Our general clinic session has been and will continue to be one of the most important sessions of our annual meetings. Those who contribute to the success of these clinic sessions give much of their time, thought, and effort, and generally receive little, if any, credit. The award will also serve to remind us of a former member of this Association, one of the early founders, who was one of that group, each year becoming less in number, to whom we and those who follow us will always be indebted for their efforts to promote progress in this specialty of dentistry.

Martin Dewey was a scholar with great ability as a teacher; he was an ever-ready defender of his views and opinions, a quality which few possess, but one greatly needed as we endeavor to progress. To many of this Association the memory of Martin Dewey will ever, as in the past, continue to be a guiding influence. I personally owe him much that I could never repay.

Therefore, it is an honor and a privilege to present the certificate, as directed by the Award Committee, to Dr. Howard E. Strange, for his contribution to the general clinic sessions.

Dr. Howard E. Strange.—Mr. President, Dr. Spencer, members, and guests: I am deeply moved, and at this time it is my desire to express my appreciation for the Martin Dewey Award. Other persons who presented clinics at this meeting are equally as deserving of this award.

There have been several chapters in my short career in the practice of orthodontics, and each chapter has been influenced by men who have stimulated me to endeavor to practice better clinical orthodontics. My dear friend, Dr. Charles R. Baker, was my first teacher. His words of wisdom have continually been very

beneficial to me. Dr. Baker is the man who gave me my start. The next man, Dr. Allan G. Brodie, is one whom I respect very highly. His thoughtful words deserve the attention of every orthodontist. Another great teacher who has had a very definite influence on my career is Dr. Robert H. W. Strang who, through his teaching, rescued me from the depths of confusion. The last man is that little giant from Arizona, Dr. Charles R. Tweed. His practical, clear, and honest thinking is stimulating to any man who comes in contact with him. I have a great deal of respect and admiration for these men. Their inspiring words have inculcated in me the desire to render better service to my patients.

DR. HOWARD E. STRANGE

I also want to express my appreciation to two very good friends of mine, whom I regard as two of the finest orthodontists in the United States. They are Dr. H. D. Kesling and Dr. Robert A Rocke, of La Porte, Indiana. A great part of my clinic is an expression of their very practical ideas regarding the problem of retention. It has been my good fortune to come in contact with these men, and, through their ideas, the retention problem in my office has practically been solved.

I am very grateful for this honor. Thank you.

Editorial

Orthodontics in the Postwar World

Present trends in health legislation and the favorable attitude toward the provision of health care for the American people on the part of industry, labor, and the public in general, foretell definite postwar changes in the practice of the health service professions. These changes are bound to show acceleration during the so-called "reconversion period," immediately after the much desired peace eventuates, when thousands of physicians and dentists, along with millions of other servicemen are returned to civilian life. It is unreasonable for orthodontists to believe that they will remain beyond the pale of social change.

Speaking on "Beveridge—and the Future of Orthodontics,"* before the British Society for the Study of Orthodontics, Robert Cutler states:

"We, as a specialist fraternity, are in a much stronger position [*than the general practitioner*], if only in so far as benefit can accrue to the populace from the labours of our hands, *and ours only,* so that we should have no difficulty whatsoever in creating conditions of service entirely satisfactory to ourselves. Whether or not it is agreed that our position is intrinsically strong, we should by no means blind ourselves to the very real shortcomings of our prewar activities in the specialty of orthodontics, which will have to take its place in the general framework of postwar dental service.

"Indeed we must face these shortcomings frankly and show how within our own autonomy we can overcome them if our case against enforced reorganization from without is to be complete."

Cutler advises the orthodontists to consider primarily the value placed on orthodontic treatment by the general practitioner of dentistry, by parents, and by public health workers. Today, it is usually the mother who sees to it that the child receives orthodontic care because she considers the child's malocclusion detrimental to appearance. The result of this is that the orthodontist receives for treatment late, well-established cases of malocclusion, which by their very nature require expert attention and prolonged treatment, both of which of necessity drive upward the cost to the patient.

Most public health personnel have little or no knowledge concerning the entailments of orthodontics as far as its mental, dental, esthetic, and socioeconomic values to the child are concerned. Much less are these values, as may be expected, understood by the politicians seeking to throw a sop to their constituents at no effort or expense to themselves. Politically speaking, orthodontics is a minority within a minority. The voice of dentistry carries little political weight and that of orthodontics even less.

The danger to orthodontics of continuing along the foregoing line under any program for the provision of dental care on a mass population basis lies in the

*Dental Record 64: 132-140, June, 1944.

fact that the public health workers and the public, without consulting the orthodontists and without the benefit of accumulated orthodontic knowledge, will seek to reduce the cost of treatment at the expense of orthodontics as a specialty. It should be the primary duty of orthodontists, therefore, to prepare for the provision of orthodontic care in dental programs on a population basis. This can be accomplished through intensive study of preventive procedures, and through experimentation in early treatment of incipient dentofacial abnormalities, over short intervals of time, to eliminate factors which threaten interference with the continued growth of the jaws, the development of the dentition, and the optimum occlusion of the teeth.

While our "experts" within the specialty are at present discussing the best method whereby "perfect results" may be achieved in isolated cases, the entire specialty of orthodontics as it is practiced today is in grave danger of being relegated to limbo unless we mend our public health relations and give more thought to social problems. It is important at this time for orthodontists to determine which types of malocclusion should be included under programs of dental care where the fee is not paid directly by the patient, his parents or guardians. We must ask ourselves whether correction of dentofacial disturbances which require months and even years of specialized treatment can be included under such programs. Obviously, orthodontics, as it is practiced at present, cannot be provided on a total population basis.

Cutler gives a basis for determining the extent of orthodontic treatment on a population basis, as follows: "The *degree* of importance would seem to depend upon recognition of the *extent* to which the growth of dental abnormality and lack of remedial treatment interfere with accepted standards of health, happiness, and biting efficiency of persons in general." In addition, esthetics impaired by severe malocclusion are to be given due consideration.

In order to keep abreast of developments in the provision of orthodontic care on a population basis, the British Society for the Study of Orthodontics, in 1942, appointed a special committee. This committee has prepared memoranda on education, postgraduate teaching, and treatment of the elementary school child. These data have been included in the report of the Interdepartmental Committee on Dentistry of the British Government.

Under any socialized insurance or prepayment scheme, parents will make more frequent demands for treatment of advanced cases of malocclusion. In order to cope with the increased demands, slipshod methods and harmful panaceas are bound to come to the fore, which will retard orthodontic advancement for a long time if they do not ruin the specialty altogether.

What are we to do? In addition to a program of study and experimentation on the provision of orthodontic care for children on a community basis, orthodontics also has a public relations job of the first magnitude on its hands. It must set itself right not only with the social workers, the public health personnel, and the public, but with the general practitioner of dentistry as well. The misunderstanding, if not open animosity, that has existed in the past between the specialist in orthodontics and the general practitioner of dentistry is too well known to require elaboration here. This untoward relationship is today more marked than ever before.

Our primary job in establishing proper relations with the general practitioner is not so much to "educate the dentist" to love the orthodontist, but rather to enlarge on the former's sympathetic approach to malocclusion as it exists in the mouths of the children of our country and to re-emphasize the basic principles on which the practice of orthodontics rests.

As we see it, it is not the special technical methods employed, or the rights and privileges—or even the headaches—of the orthodontist that interest the general practitioner of dentistry. The dentist wants to know what he can do for the child to check incipient malocclusion before extensive mechanical therapy becomes necessary. He is anxious to know whether the specific dental development shown by the individual child will permit normal occlusion to establish itself. The dentist in general practice, for example, who understands the importance of caring for deciduous teeth, would like to be told more about the indications for extracting such teeth when retained to the point where their presence in the mouth becomes a menace to the establishment of the normal occlusion of the oncoming permanent dentition. He would like to know more about habits which affect the dentofacial zone.

The dentist in general practice would like to know more about all of the foregoing and many other facts relating to the development of the teeth and the establishment of the occlusion, so that he may be able to give intelligent advice to inquiring mothers. Furthermore, he would like to increase his awareness of the presence of threats to the normal development of the dentition and occlusion of the child, so that he may be able to call these conditions to the attention of parents before the pediatrician, the parents themselves, or other laymen, in turn bring these conditions to the attention of the dentist, who in the meantime has been filling cavities in the child's mouth without giving any thought to the presence of the aforementioned interferences to the establishment of the optimum occlusion of the teeth.

We realize, of course, that specialists in orthodontics are themselves far from being in agreement on the recognition and relative importance of many of the basic principles of their specialty. This should not stop them, however, from presenting authoritative points of view, accepted trends of thought, and acceptable methods of procedure. Here is a job well worthy of the best brains in orthodontics. The American Association of Orthodontics should give early consideration to this problem.

J. A. Salzmann, D.D.S.

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American Association of Orthodontists
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Dr. Allen Collins
Detroit, Mich.
Dr. R. Burke Coomer
Louisville, Ky.
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Dr. Marion A. Flesher
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Dr. Murray M. Hall
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Dr. George S. Harris
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Dr. J. S. Hoffer
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American Association of Orthodontists
Serving in the Armed Forces

(Continued)

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Dr. E. B. Pulliam
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Santa Rosa, Calif.
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Dr. S. H. Yoffe
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Dr. Sidney Zeitz
Brooklyn, N. Y.

Regular Army Service Members

Col. Harry Deiber
Col. Neal Harper
Col. Wm. H. Siefert
Col. Richard F. Thompson
Col. L. B. Wright

There may be members in the Service whose names do not appear in the above list. These members should notify the secretary at once so that their names may be included.

Max E. Ernst, Secretary, American Association of Orthodontists, 1250 Lowry Medical Arts Bldg., St. Paul, Minn.

Department of Orthodontic Abstracts and Reviews

Edited by

DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

Tratado de Ortodoncia. By Armando E. Monti, Professor Adjunto de Ortononcia con Odontologia Legal de la Facultad de Ciencias Medicas de Buenos Aires. Jefe de la division Odontologica de la Direccion de Maternidad e Enfancia, sub-director del Instituto de Ortodontologia, Odontologia legal e Historia de la Odontologia, de la Faclutad de Ciencias Medicas de Buenos Aires. Prologo del Dr. Juan U. Carrea, Professor Tetular de la Catedra de Ortodoncia con Odontologia Legal de la Facultad de Ciencias Medicas de Buenos Aires. 2 vols. Libreria y Editorial "El Abeneo," Buenos Aires, 1942.

Monti has rendered a signal service to the Spanish-speaking dentists and orthodontists throughout the world by the publication of this work. In these two volumes, the author has gathered the principles of orthodontics from the standpoint of the basic sciences. Volume I is divided into nine parts and discusses the history of orthodontics; growth and development of the cranium and the jaws; nomenclature; etiology of malocclusion; diagnosis, classification, phonetics, prognosis, and therapeutics in orthodontics besides mechanics. Volume II includes the study of pathologic changes of the tissues, anchorage, orthodontic forces, and the various appliances employed in orthodontics. In conclusion, a series of case reports is presented with outlines of treatment of each case.

In the chapter on the history of orthodontics, Monti presents summaries of the contributions of outstanding orthodontists to 1941. Keith and Campion are the source of most of the chapter on growth and development of the head. In the chapter on growth of the teeth, excellent color illustrations are included of moulages made by Professor H. Aprile of Buenos Aires.

The chapters on the muscles of expression and mastication are unusually well illustrated with a wealth of original drawings and Rogers' muscle therapy is discussed in detail.

Anchorage and the forces exerted by orthodontic appliances are discussed and illustrated in great detail. Construction of bands is presented and illus-

trated. The construction of the various types of appliances is presented, with adequate illustrations. A valuable bibliography is appended.

The Spanish-speaking orthodontist and dentist as well as the student of orthodontics, regardless of the language he speaks, will find here a work of encyclopedic proportions which will be useful both as a text and as a book of reference to the contributions of European, American, and Latin-American authors.

—*J. A. Salzmann.*

Orthodontic Analysis: By G. F. Walker, B.D.S., *New Zealand D. J.* **40**: 14-17, January, 1944.

The analysis was undertaken to find, if possible, any further indications as to the causes of the appalling dental condition of the people of New Zealand and possible means for their alleviation, or fields where further research is needed.

The material was supplied by the Orthodontic Department of the Dental School of Otago, New Zealand, and covers cases during approximately the last eight years.

CAUSES OF MALOCCLUSION (ANGLE CLASSIFICATION)

Class I:	
General Lack of Development:	Cases
(a) Premature loss of deciduous molars	216
(144 had history of close-bite)	
(b) Lack of development of alveolus	286
(94 had history of close-bite)	
Interference With Normal Development:	
(a) Specific habit of finger- and thumb-biting, etc.	64
(b) Retention of deciduous teeth	9
(c) Lost of first permanent molars prematurely	9
(d) Abnormal frenum	2
Causes Indefinite or Unknown	37
	623
Class II:	
General Lack of Development:	Cases
(a) Underdeveloped maxilla and mandible	63
(b) Premature loss of deciduous teeth	17
Interference With Development:	
(a) Specific habits:	
Finger- and thumb-sucking	36
Mouth breathing	47
Causes Unknown	18
	181

Class III:

Growth and Development:	Cases
(a) Small maxilla and premaxilla	12
(b) Habits:	
Tonsil hypertrophy	2
Mouth breathing	2
Causes Unknown	7
	23

From this we see that most malocclusions (75 per cent) are Class I, and of these five-sixths are due to caries or lack of development of the growing jaws. The great number of malocclusions brought about by premature loss of the deciduous teeth came as a surprise to me, and my present opinion is that it is probably brought about fundamentally in two ways:

(a) Mesial drifting of first permanent molars due to growth and eruption of second molars. (In my experience first permanent molars never drift distally without the help of a finger spring or, in some cases, of abnormal occlusion.)

(b) Lack of approximal and occlusal contact tending to reduce the stimuli necessary to growth and development of the jaws.

The most efficient preventive measure for this cause of malocclusion is, obviously, retention of deciduous teeth till the proper period of exfoliation.

The other important cause of malocclusion is the lack of development of the jaws. Generally speaking, all jaws will attain to a perfectly developed size and shape, depending on the general physical type of the individual, if the stimulation and nutrition are adequate. When these are inadequate, the underlying hereditary factors vary the malocclusion, and so various typical malocclusions develop. It may be possible for a more than usually dominant hereditary factor to cause a malocclusion, but from a broad general study of ancient and modern races they would appear to be remarkably rare.

It logically follows, therefore, that the growing number of malocclusions in this country are to a certain extent preventable without recourse to such complicated aids as orthodontic appliances. It is not economically sound to provide these for all that need them. What we need are exercises for the development of the cheeks and tongue, i.e., artificial aids to compensate for our artificial environment and a parallel to such aids as toothbrushes for the teeth and exercise for the limbs. These are quite simple and effective, as I have been able to demonstrate in many of my patients. To do the most good, however, instruction must be widespread; and dentists and dental nurses should find that the inauguration of exercises, and advice to encourage more vigorous mastication, tend to correct incipient malocclusions. In some cases where growth would be still insufficient, reduction of the tooth volume by judicious extraction may be necessary to get the best results. In many cases, orthodontic appliances may be needed, but from casual observations the orthodontist can treat only a fraction of the public, while public education and artificial preventive measures provide for the most logical and beneficial means of correction.

This simple remedy may sound too optimistic, but experience shows that, if intelligently applied, only improvements could result. It should, at least, be cheap enough to try.

A Free Diagnostic Service for Michigan Dentists: By C. Ray Taylor, D.D.S., Bureau of Public Health Dentistry, Michigan Department of Health, *Michigan Public Health* **32**: 150-151, August, 1944.

There is available ample evidence of a close correlation between the number of *Lactobacillus acidophilus* organisms in the saliva and the degree of dental caries activity. It is generally accepted by most research groups that a saliva test can be used as a definite indicator of caries activity. If such a test reveals a lactobacillus count of 10,000 or over, new cavities will appear within a few months. If the lactobacillus count is negative or low, caries will be inactive.

Based on the work of the research group at the School of Dentistry, University of Michigan, a test has been worked out for determining the number of lactobacilli in the mouth, and a reduction of caries has been made possible by temporary periodic dietary changes.

The Michigan Department of Health will make available, by September, a saliva diagnostic service for use without charge by all dentists in Michigan. The state or local health department will supply the dentist with a double container in which there will be a sterile bottle, a pellet of paraffin, and a report sheet to be filled in by the dentist. Instructions for collecting the patient's saliva are included. The sample is to be returned to the Bureau of Laboratories, Michigan Department of Health, for analysis.

Should the laboratory report indicate a high lactobacillus count (over 10,000), the patient will be advised by the dentist to follow a diet in which the daily carbohydrate intake is restricted to approximately 100 grams. This diet contains no sugar, very little starch, and no potatoes or bread.

After two weeks on this diet, another saliva specimen is sent in, and the patient is permitted to restore bread and potatoes to the diet for two weeks. Another check is made, and if the lactobacillus count is not increased, a moderate amount of sugar may be added. Another test after two weeks will indicate whether the patient can return to the unrestricted diet.

A large percentage of susceptible cooperative individuals will respond very satisfactorily to these dietary changes during the six weeks period.

Periodic saliva analysis, thereafter, will indicate whether or not the patient has a negative or low count. If so, he may tolerate considerable amounts of sugar without a corresponding increase in caries activity.

News and Notes

American Association of Orthodontists, 1945 Meeting

By vote of the Board of Directors of the American Association of Orthodontists, the dates of May 21 to 24, 1945, have been decided upon for the next annual meeting.

The meeting will be held at the spacious Broadmoor Hotel, located at the foothills of the Rocky Mountains, Colorado Springs, Colorado.

President Archie Brusse and his committees have started working vigorously on the program and general arrangements for this meeting. All orthodontists should plan now to arrange their time and work so that they will be able to attend this meeting. It is not often that a scientific meeting can be held in the outdoor atmosphere that is reflected in the stage setting of the Broadmoor Hotel, and this is another reason why attendance should be large.

The following committees have either been appointed or elected for the coming year:

Judicial Council
R. C. Willett, Chairman
John Ross
Joseph C. Eby

Budget
W. A. Murray, Chairman
Claude R. Wood
Samuel D. Gore

Research
Allen G. Brodie, Chairman
Milo Hellman (renominated)
B. Holly Broadbent

Public Relations
H. B. Robison, Chairman
Henry U. Barber
Harold Noyes

Education
L. M. Waugh, Chairman
George M. Anderson
Walter McFall

Constitutional Administration Bylaws
Oren A. Oliver, Chairman
H. C. Pollock
Philip E. Adams

Editor Publications
E. C. Lunsford, Chairman
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Reuben L. Blake
Max E. Ernst

Laws and Infractions
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L. M. Waugh
Stanley S. Crouch
John R. McCoy
Wm. B. Stevenson

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W. R. Humphrey, Chairman
Reuben L. Blake
George H. Siersma

Nomenclature
James D. McCoy, Chairman
George R. Moore
Kyrle Preis

Necrology
Leigh C. Fairbank, Chairman
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Robert L. Gray
Oliver H. Devitt
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Commercial Exhibits
K. E. Taylor

Librarian
Richard A. Smith

Relief
E. B. Arnold, Chairman
George H. Siersma
Hays N. Nance

Inter-Relations
Geo. M. Anderson, Chairman
John W. Ross
Vernon G. Fish

Pacific Coast Society of Orthodontists

EXCERPTS FROM PRESIDENT'S REPORT ON NEXT GENERAL MEETING

Concerning the annual meeting of the Pacific Coast Society of Orthodontists, to be held Feb. 20 to 22, 1945, the following comments are quoted from the report of the President, Dr. J. Camp Dean:

"We have problems to be discussed of particular interest to us here. We are confused by the various techniques practiced by our members. Dr. Atkinson is teaching the universal system at the University of Southern California. California is known as an Angle school. Dr. Fred West, at the College of Physicians and Surgeons, is teaching the labio-lingual arch technique, as is the Northwest Pacific College. Some are using the Johnson twin arch, which is growing in popularity both in the East and Midwest. These are complicated systems and applying them successfully requires long study. The Program Committee plans a sort of postgraduate course covering the four more recent techniques. Dr. Chuck will head the edgewise arch clinic, Dr. McCoy, the open tube, Dr. Atkinson, the universal, and Dr. Joe Johnson and Dr. Alderson the twin arch.

"The subject of extraction as a means of orthodontic treatment probably affects us more vitally here on the Coast than in any other section, due to the wide influence of Dr. Tweed. The papers read at the Chicago meeting and published in the August issue of the JOURNAL open the subject for further discussion. It recalls the bitter discussion between Dr. Angle and Dr. Calvin Case years ago. Dr. Hays Nance is on the program with a very scientific discussion of mixed dentures, predetermining the possibility of extraction. Dr. Joe Johnson will present his fine paper on the treatment of compromise cases. Dr. Oppenheim will review his research studies on reaction of bone growth to orthodontic stimuli. These are just some of the highlights of the program planned."

NORTHERN SECTION

A special dinner meeting of the Northern Section of the Pacific Coast Society of Orthodontists was held at the Washington Athletic Club in Seattle, Friday, August 4.

The special guest and speaker was Professor Wilton M. Krogman of the University of Chicago, the leading figure in Anthropology, who has been lecturing this summer at the University of Washington. His subject was "Recent Studies of Heredity on the Face and Teeth." He gave our group a very interesting and instructive evening. His talk showed a background of much study and experience in our field, particularly pointing out that treatment should coordinate the proper age and the dynamic forces.

An election of officers was held and the following were elected: Chairman, Donald C. MacEwan, Seattle; Secretary-Treasurer, Harry N. Moore, Seattle; and Harry Moore was also elected as our delegate.

SOUTHERN SECTION

The Southern Section of the Pacific Coast Society of Orthodontists has held no meeting since May.

Pan-American Society

The Division of Inter-American Relations reports that hundreds of Pan-American Clubs have been formed in the United States, in junior and senior high schools, as well as in colleges. The adult public, however, has not been afforded such opportunities for learning Spanish as are to be found in educational institutions. Throughout South America, hemispherical-minded newspapers and magazines are carrying regular lessons in English.

More than three hundred Spanish and English words are spelled exactly the same. Simple rules for changing the endings of thousands of English words automatically convert them to Spanish words of similar meaning. It is possible, then, for the average North

American, whether of school age or adult years, to acquire a rather extensive smattering of the Spanish language with a minimum of study and effort, through learning which English and Spanish words are identical in spelling and which English words may be readily converted to Spanish by the easy expedient of changing the endings.

The Pan-American Society has prepared a free pamphlet which describes the words and endings referred to above. These instructions are available without any charge or obligation whatever, to all North Americans who wish to send for them.

Applicants for the pamphlet on Simplified Spanish need only to send their names and addresses to: Pan-American Society, Box 315, Quito, Ecuador, South America.

The pamphlets were prepared by Professor Señor Don Arturo Montesinos M., especially for free distribution in North America by the Pan-American Society through their Quinto offices. Señor Montesinos is Professor of English at the Colegio Militar, Ecuador's "West Point."

These pamphlets are not for sale, and the statement: "For Free Distribution in North America" is printed on the covers.

Generous assistance in making this offer known to the North American public is requested. The offer is good throughout the balance of 1944 and all of 1945.

Applicants should be patient in waiting for their complimentary pamphlets, since the regular ship mails between the Americas are somewhat irregular during these times.

M. A. ALVAREZ, Secretary, Pan-American Society, Quito, Ecuador, South America.

American Board of Orthodontics

The orthodontists certificated by the American Board of Orthodontics during its 1944 session are as follows:

Daniel Thomas Carr
Max J. Futterman*
Lawrence W. Gange
Arthur V. Greenstein
Scott Travis Holmes
Harry Elihu Jerrold
Eugene J. Kelly
C. Edward Martinek
Ben L. Reese
Sherwood Reed Steadman
Donald Spencer Sterrett
Robert H. W. Strang

American Association of Orthodontists, Amendments to Bylaws

At the meeting of the American Association of Orthodontists in Chicago, April 25 to 27, 1944, the following amendments to the constitutional bylaws were adopted:

The New York Society of Orthodontists shall consist of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, Pennsylvania east of the Alleghenies, New York, New Jersey, Delaware, Maryland, District of Columbia, and the provinces of Quebec, New Brunswick, Prince Edward Island, and Nova Scotia in the Dominion of Canada.

The Southern Society of Orthodontists shall consist of Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Tennessee, Kentucky, Mississippi, and Louisiana east of the Mississippi River.

The Great Lakes Society of Orthodontists shall consist of Michigan, Ohio, Indiana, Pennsylvania west of the Alleghenies, West Virginia, and the province of Ontario in the Dominion of Canada.

*Posthumously certificated.

The Central Section of the American Association of Orthodontists shall consist of Illinois, Wisconsin, Minnnesota, North Dakota, South Dakota, Nebraska, Iowa, Missouri, and the provinces of Manitoba, Alberta, and Saskatchewan in the Dominion of Canada.

The Southwestern Society of Orthodontists shall consist of Kansas, Oklahoma, Texas, Arkansas, and Louisiana west of the Mississippi River.

The Rocky Mountain Society of Orthodontists shall consist of Wyoming, Utah, Colorado, and New Mexico.

The Pacific Coast Society of Orthodontists shall consist of California, Oregon, Washington, Arizona, Nevada, Montana, Idaho, Alaska, Hawaiian Islands, Philippine Islands, and the province of British Columbia in the Dominion of Canada.

The following resolution was passed by the Board of Directors: That it be the sense of the Board that the time spent in graduate instruction in a recognized school of dentistry in a university be considered as part of the requirement of three years of exclusive practice necessary for membership in the Association.

The report of the Secretary, at the meeting in Chicago, showed that the active membership of the Association numbered 721, an increase of 51 since the New Orleans meeting in 1942. Dr. Joseph L. T. Appleton and Dr. Clinton C. Howard were elected to honorary membership at the meeting.

MAX E. ERNST, Secretary.

Graduate School of Medicine, University of Pennsylvania

The Graduate School of Medicine of the University of Pennsylvania, organized in 1916 to provide for graduate studies in clinical medicine, has enlarged the scope of its activities to include graduate studies in dentistry, according to announcement by Dr. George Wm. McClelland, President of the University.

The graduate dental studies will be under the direction of Dr. John W. Ross, who has been appointed Vice-Dean for Dentistry in the Graduate School of Medicine. He will work in cooperation with the vice-deans for other medical studies under Dr. Robin C. Buerki, Dean of the Graduate School of Medicine.

In connection with the new graduate program in dentistry, courses are being planned for graduate studies in oral surgery, orthodontics, prosthetics, and oral medicine-periodontics, according to Dr. Buerki.

The first period of study for those students entering the graduate program will be devoted to basic studies involving the medical sciences as applied to the clinical specialties concerned, together with the principles and practice of that specialty, and its relation to other clinical specialties. The studies of this period will lead to a certificate.

The second period of study will be under preceptors, and this period must be preceded by the basic studies at the University. The studies under the preceptors may be carried on at any approved institution, and academic credit will be granted for them by the University provided the specific plan for such studies for each candidate receives due approval and acceptance by the University.

The successful completion of the period of study carried on under the preceptors will lead to the degree of Master of Science in dentistry.

Dr. Buerki pointed out that the program in dentistry in the Graduate School of Medicine will be independent of the School of Dentistry at the University, but that the two schools will work in complete accord, and facilities and faculty of the School of Dentistry will be available for the graduate studies and special work in the respective clinical fields.

Dr. Ross, who has long been prominent in the dental profession, was graduated from the School of dentistry at Pennsylvania in 1917 and was an instructor in orthodontics there from 1918 to 1924. He taught in the advanced course in orthodontics at Columbia University from 1929 to 1939.

He is a past President of the Academy of Stomatology, Secretary and Treasurer of the Inter-American Orthodontic Congress, a director of the American Association of Orthodontists, and a member of the Council on Dental Health of the Pennsylvania State Dental Society.

He also is director of dental personnel for the Philadelphia Council of Defense and serves on the advisory committee of the New York Society of Orthodontists, and on the international relations committee of the American Dental Association.

Ration Test Concluded

The most extensive controlled ration test ever conducted using United States military personnel has just been concluded with highly satisfactory results. Major William Beane, M.C., of the Armored Medical Research Laboratory, Fort Knox, Ky., directed the test in cooperation with Major James Robinson, Inf., and Captain David Bell of the Royal Canadian Medical Corps. American and Canadian expeditionary rations were used.

A battalion of American soldiers on maneuvers at an altitude of 8,850 feet above sea level in Colorado were fed exclusively on American rations C, K, 10 in 1, and Canadian Mess Tin B ration for a period of 60 days. During this time they were engaged in vigorous combat training.

At the conclusion of the test it was found that the troops were in better physical condition than at the start, with high morale. The rations were proved to be wholly adequate to sustain troops in vigorous combat. Certain items in the rations, however, were found to be less acceptable to the men than others, and these will be improved.

Four consultants in nutrition to the Surgeon General, Dr. Julian M. Ruffin, Dr. Frederick J. Stare, Dr. R. H. Kampmeier, and Dr. Virgil P. Sydenstricker, assisted in the physical examinations. Dr. Albert Mendeloff and Dr. Carleton B. Chapman of the Public Health Service also aided in the test. A unit from the Harvard Fatigue Laboratory under Dr. R. E. Johnson performed the laboratory examinations.

Nutrition Consultants Appointed

As Allied forces advance, they are confronted with vast problems of nutrition among the undernourished civil populations in former enemy-held territory. To help the Army meet the initial responsibility, as well as to advise on problems of nutrition among our military forces, a group of experts in nutrition have been appointed consultants to the Surgeon General. The new appointees include:

Dr. Otto A. Bessey, Chief of the Division of Nutrition and Physiology, and Director, Public Health Research Institute, New York City; Editorial Board of *The Journal of Nutrition;* Assistant Editor of *Nutrition Reviews.*

Dr. E. V. McCollum, Research Professor of Biochemistry, School of Hygiene and Public Health, Johns Hopkins University; member of the Food and Nutrition Board, National Research Council; Scientific Advisory Committee, Nutrition Foundation; member of the National Academy of Sciences.

Dr. Julian M. Ruffin, Associate Professor of Medicine, Duke University, Durham, N. C.

Dr. Frederick J. Stare, Associate Professor of Nutrition, School of Public Health, Harvard University; Associate in Medicine, Peter Bent Brigham Hospital, Boston, Mass.; Editor, *Nutrition Reviews.*

Dr. Harold C. Stuart, Director, Center for Research in Child Health and Development, and Department of Child Hygiene, Harvard School of Public Health; Assistant Professor of Pediatrics and Child Hygiene, Harvard Medical and Public Health School; member of Rockefeller Foundation Health Commission to Europe, 1941; American Pediatric Society; Academy of Pediatrics; and American Board of Pediatricians.

Dr. Virgil P. Sydenstricker, Professor of Medicine, University of Georgia, and Physician in Chief, University Hospital; member of Food and Nutrition Board, National Research Council; Consultant in Nutrition, Office of Scientific Research and Development, U. S. Government; and former Consultant in nutrition to British Ministry of Health.

Prize Essay Contest

The Research Committee of the American Association of Orthodontists is empowered by the Board of Directors to conduct a prize essay contest. The prize has been set at $200.00 and will be offered annually until further notice. The terms of the competition are as follows:

Eligibility.—Any student enrolled in a recognized university, or any person who has completed his or her formal education in orthodontics not more than two years prior to Jan. 1, 1945, is eligible to compete for the prize.

Essay.—The essay must represent a piece of original research having a direct bearing on the field of orthodontics. It may relate either to a biological or clinical problem and may represent material that has been offered in partial fulfillment of the requirements of a graduate or postgraduate degree, or any graduate, postgraduate or undergraduate contest. No papers previously submitted for publication or in press will be accepted. All essays must be in the hands of the committee not later than two months prior to the annual meeting of the Association. Consult periodic literature for this date. If no essay is deemed worthy by the committee, the prize will be withheld.

Award.—The prize-winning essay will be accorded a place on the scientific program of the annual meeting of the Association, at which time the prize will be awarded. The Association will retain publication rights of the first three choices.

For further information, address

ALLAN G. BRODIE, Chairman. Research Committee, A.A.O., 30 North Michigan Ave., Chicago 2, Ill.

Several Hundred Dental Officers to Be Relieved From Active Duty

With the peak of the Army's work load past, several hundred dental officers will be relieved from active duty with the Army shortly, permitting their return to private practice.

Thomas P. Hinman Mid-Winter Clinic

The Thomas P. Hinman Mid-Winter Clinic will be held at the Municipal Auditorium, Atlanta, Georgia, on March 25, 26, and 27, 1945.

Notes of Interest

Lieut. Col. Claude R. Wood, Belleville, Illinois, has been named post dental surgeon at Scott Field, parent radio school of the Army Air Forces Training Command.

Lieutenant Colonel Wood is President of the Inter-American Orthodontic Congress, Editor of the *Orthodontic Directory of the World*, a director of the American Board of Orthodontics, and a member of the American Association of Orthodontists, of which he was secretary for ten years.

The new address of Dr. Ralph Connell is 358 Commonwealth Avenue, Boston, Massachusetts. Practice limited to orthodontics.

Dr. Earl C. Bean, Major, U. S. Army, Retired, announces that he will resume his practice Nov. 1, 1944, Suite 330-333 University Club Building, Grand and Washington Avenues, St. Louis, Missouri. For the continuance of the practice of orthodontics.

OFFICERS OF ORTHODONTIC SOCIETIES*

American Association of Orthodontists

President, Archie B. Brusse - - - - - - - - - - 1558 Humboldt St., Denver, Colo.
President-Elect, Earl G. Jones - - - - - - - - - 185 East State St., Columbus, Ohio
Vice-President, Will G. Sheffer - - - - - - - - Medico-Dental Bldg., San Jose, Calif.
Secretary-Treasurer, Max E. Ernst - - - 1250 Lowry Medical Arts Bldg., St. Paul, Minn.

Central Section of the American Association of Orthodontists

President, Arthur C. Rohde - - - - - - - - 324 E. Washington Ave., Milwaukee, Wis.
Secretary-Treasurer, L. B. Higley - - - - - - - 705 S. Summit St., Iowa City, Iowa

Great Lakes Society of Orthodontists

President, Henry D. Cossitt - - - - - - - - - - - 942 Nicholas Bldg., Toledo, Ohio
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Ellis Fischel State Cancer Hospital Number

SYMPOSIUM ON TWENTY CASES OF BENIGN AND MALIGNANT LESIONS OF THE ORAL CAVITY, FROM THE ELLIS FISCHEL STATE CANCER HOSPITAL, COLUMBIA, MISSOURI

Wilson N. Burford, D.D.S.,* Lauren V. Ackerman, M.D.,† and Hamilton B. G. Robinson, M.S., D.D.S.‡

INTRODUCTION

The Ellis Fischel State Cancer Hospital has had 6,200 admissions in its four-year history. Many of these have presented dental problems and, in 694 instances, the primary lesions have been in the oral cavity. It should be realized that all of our patients are admitted for cancer or suspected cancer. Here lies a ready answer for anyone who may decry the role of the dentist in modern cancer therapy or the man who claims that he has never seen cancer in the mouth. It is estimated that 203,000 people will die from cancer in 1950. Realizing that oral cancer represents a small but important segment of these probable cancer victims, it is evident that the dentist has an important part in this battle against the second highest cause of deaths in the United States.

The following cases are presented as typical of those seen in a state cancer institute. Some of them may represent the type of case that you have passed by or treated lightly. These are the lesions seen in our hospital from day to day and year to year. It is your responsibility to get these people into competent hands in time for efficient therapy.

I. LYMPHOSARCOMA IN A CHILD

Case 1, D. J., EFSCH No. 4502

Introduction.—McGavie[1] reported a series of twenty-one cases of lymphosarcomas and allied diseases, seventeen of which arose primarily from the eye and its adnexa. The other four invaded it secondarily. The following case is distinctly unusual in that this lymphosarcoma occurred in a child of 3 years, invaded the orbit, and affected the entire left side of the face.

This 3-year-old white female child was first seen in the clinic in September, 1942. Her father said that over a year before the child had fallen on her face, bruising the soft tissues and causing hemorrhage from the mouth and nose. The traumatic swelling quickly subsided, but a few weeks later the father noticed that the left eye was constantly turned upward. The local physician made a

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diagnosis of sinusitis and prescribed nose drops, but they offered no improvement. Swelling under the left eye was again noticed and the father sought treatment for the child elsewhere. The baby finally received four x-ray treatments to the region of the left eye, dosage unknown, with some regression of the swelling. Shortly after these x-ray treatments, the swelling recurred and had been rapidly increasing until the time when we first saw her. There had been very little functional impairment other than to the left eye. She had been able to eat and had had no difficulty in swallowing or breathing. There had been a weight loss of only 7 pounds in the past year.

Examination revealed swelling and deformity of the entire left side of the face. The lower left eyelid was edematous, the edema involving the conjunctiva of the eye. Immediately inferior to the left eyelid, there was a draining sinus. The tumor mass was growing in all directions and extended through the left angle of the open mouth. The crowns of incompletely formed teeth were seen scattered over the tumor mass. The portion of the tumor which extended out of the mouth was superficially ulcerated and foul-smelling. The patient was admitted for x-ray studies, diagnosis, and palliative therapy.

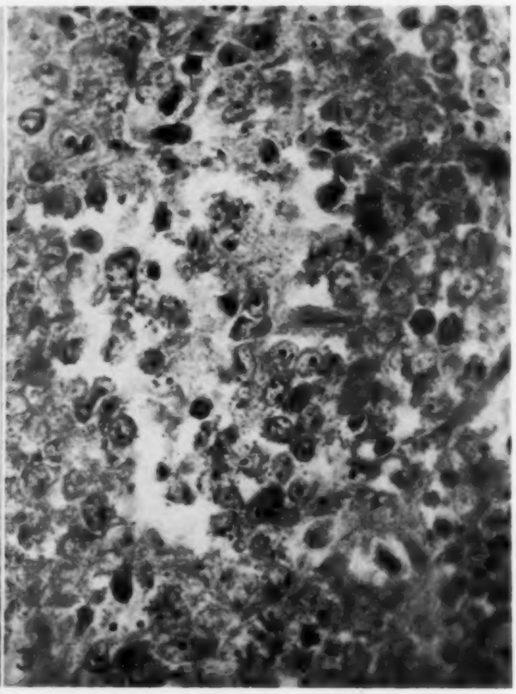

Fig. 2.—Case 1. Lateral radiograph of Case 1, showing mass of soft tissue density with misplaced unerupted permanent teeth.

Fig. 3.—Case 1. Photomicrograph of tumor. Lymphosarcoma. (High power.)

X-ray examination revealed an enormous soft tissue tumefaction of variable density extending left laterally from the inferior left lateral maxillary region and containing several displaced tooth buds. There was complete destruction of the entire antrum, the alveolar portion of the maxilla, a portion of the hard palate, the lateral walls of the left nasal space, the inferior aspect of the left orbit, the greater portion of the zygoma, and the regions of the lachrymal bones and the ethmoids on the left. (Fig. 2.)

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Fig. 1.—Case 1. Lymphosarcoma.

Gross Description.—A very small irregular piece of tissue was submitted for examination. Microscopically it showed fairly uniform-appearing tumor cells with pale blue nuclei, innumerable mitotic figures, and poorly defined cytoplasmic outline.

Microscopic Diagnosis.—Lymphosarcoma (Fig. 3).

She received 225 r. of radiotherapy through two large fields, after which her father signed her out under protest. A letter from the county nurse stated that the child expired, Nov. 25, 1942.

Comment.—This lymphosarcoma arose in or around the oral cavity, the exact primary site undetermined. Such extensive disease in a child, with little or no response to x-ray therapy, made the prognosis hopeless, but any lymphosarcoma in a child, as a rule, has a very poor prognosis. The total duration of disease from the first symptom to death was only fourteen months. The particular dental significance is in the field of diagnosis. At the time of injury, periodontal abscess might have been suspected and treated. While the prognosis was extremely poor, the patient was entitled to every therapeutic effort.

II. CARCINOMA OF THE ANTRUM

Case 2, J. B., EFSCH No. 5618

Introduction.—As Regato[2] has pointed out, carcinoma of the maxillary sinus is a relatively rare neoplasm. The following type of case, because of its location, is often first seen by a dentist and may be diagnosed incorrectly.

This 57-year-old white man was first seen in the clinic in September, 1943. In April, 1942, the patient had a toothache and consulted his dentist, who extracted two upper molars and incised what was thought to be a periapical abscess. This gave no relief, however, and in August a mass appeared in the right upper jaw. After consulting his local physician and after various consultations elsewhere, the patient received a total of 2,466 mg. hours of radium irradiation to the right antral region. There was some regression of the mass and relief from pain following this therapy. In September, one month after his treatment with radium, he noticed the sight of the right eye was failing, with some evidence of exophthalmus. In October, the right eyeball ruptured and there had been drainage from the socket since that time. Three weeks before our examination, the patient noticed a small amount of ulceration on the right cheek.

Examination revealed the absence of the right eye. There had been no enucleation of this eye, and apparently it had broken down after invasion by tumor. There was a visible deformity of the right maxillary region which extended into the malar region and the floor of the orbit. At the site of the right eye, there was a whitish-gray, dirty, ulcerating tumor mass which was apparently continuous with an antral mass. The remaining teeth showed untreated caries and the hard palate on the right presented a large hole partially filled with the same dirty whitish-gray mass observed previously through the floor of the right orbit. There was no palpable submaxillary or cervical lymphadenopathy. Although the previous treatment made the prognosis rather poor, the patient was admitted for x-ray therapy.

X-ray examination revealed extensive destructive bone changes involving the floor and lateral portions of the right antrum. This bone destruction included a moderate portion of the malar body on the right. A soft tissue tumefaction was seen in the antral area and in the inferior portion of the right orbit. The remaining portion of the zygomatic body on the right presented an increased density. (Fig. 4.)

A biopsy demonstrated a well-differentiated epidermoid carcinoma (Fig. 5.)

The patient was given a total of 6,500 r. units divided into two fields, one lateral and one anterior posteriorly to the right maxillary region. As a result of this, he developed a white area of moist radioepidermitis and radioepithelitis of the mucous membrane of the hard palate.

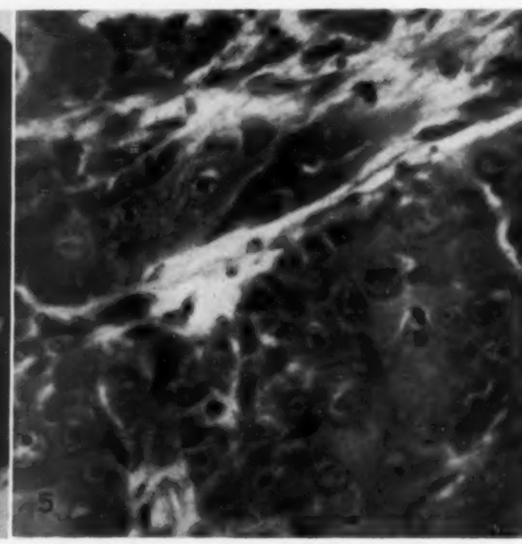


Fig. 4.—Case 2. Radiographic view of carcinoma of the right antrum.
Fig. 5.—Case 2. Photomicrograph of tumor. Epidermoid carcinoma. (High power.)

In February, 1944, there was an area of atrophic skin over the right malar eminence, the right cheek, and the right eye socket. This had been well cared for by generous applications of petroleum jelly. Mirror examination of the right antrum through the window which communicated with the vestibule of the mouth revealed many crusts and areas with false membranes. There was no palpable preauricular or cervical lymphadenopathy. The patient complained of some pain in the inferior rim of the right orbit. He was advised to irrigate the cavity of the right antrum with normal saline twice a day.

Comment.—The history of this carcinoma of the maxillary sinus is typical. These epitheliomas arising in the infrastructure of the antrum, because of their proximity to teeth and dental nerves with resultant symptoms of toothache, are often first seen by dentists. The dentist usually simply extracts some teeth or incises what he believes to be a periodontal abscess. This case was no exception. This type of tumor arising in the antral area, even if diagnosed when the first symptom appears, may be far advanced because of the opportunity for the tumor to grow silently within the maxillary sinus. The prognosis in this case is very poor because the disease was very far advanced when the patient

was first seen in our clinic. The prognosis might have been better if the patient had been referred seventeen months earlier at the time of the dental consultation.

III. METASTASIS TO THE MANDIBLE FROM A PRIMARY CARCINOMA OF THE BREAST

Case 3, S. B., EFSCH No. 3633

Introduction.—There have been reports of metastatic lesions to the mandible from carcinomas arising in the breast, thyroid, rectum, bronchus, prostate, and kidney, and from other neoplasms in the ovary and adrenal. No doubt this site of metastasis is not as rare as the literature would indicate because x-ray studies of the mandible are infrequently made when there is wide dissemination of disease. Differential diagnosis of metastatic lesions of the mandible may be difficult, for the metastasis may simulate a primary lesion, benign or malignant.[3-11]

This 78-year-old white woman was first seen in the clinic in December, 1941. Several years before (the exact time is not known), the patient noticed in her left breast a lump which slowly increased in size. In November, 1940, while bedridden with a cold, she felt something "pop" in the left jaw and shortly thereafter her jaw began to swell. Her local physician prescribed cold packs and a salve, but there was no relief. There had been mild pain in the jaw and the swelling increased in size until something "opened" inside of her mouth which drained clear fluid for a short time, after which the swelling decreased. This swelling and drainage had occurred at frequent intervals, and the chief complaint was that she could not wear her lower denture.

Examination of the face revealed a mass of the left mandible, extending from the left ear to the symphysis, which was firm and apparently fixed to the bone (Fig. 6). Intraorally, the mass was seen to be a pedunculated cystic swelling. In the anterior floor of the mouth was another swelling pushing the tongue to the right side of the midline. In the left breast, there was a mass measuring 8 by 8 cm., attached to the skin, with definite axillary metastasis. This was an obvious carcinoma. The patient was admitted for treatment, but she refused any therapy and was discharged. In May, 1942, examination revealed considerable growth of the mandibular tumor, but she still refused treatment. In February, 1943, she was again admitted, and at that time consented to x-ray studies and biopsy.

X-ray studies of the mandible revealed an enormous lobulated mass in the region of the left mandibular body and symphysis. Throughout this soft tissue mass were many irregular strands of bony substance varying in size from fine to coarse and giving the tumor a bizarre, cystlike appearance. No bony substance was noted about the margins. Destructive changes in the mandible extended to the anterior portion of the mandibular body on the right, and involved both the mandibular body and ramus on the left. The margins of the destroyed areas were irregular and serrated, indicating an invasive type of

lesion (Fig. 9). Examination of the skull revealed many small and several large circular areas of bone destruction, and in several areas both tables were involved. The margins of these defects were sharply demarcated (Fig. 8).

Pathology Report.—Aspiration of the mandibular mass microscopically revealed a rather well-differentiated carcinoma which was evidently metastatic and compatible with the primary lesion of the breast (Fig. 7).

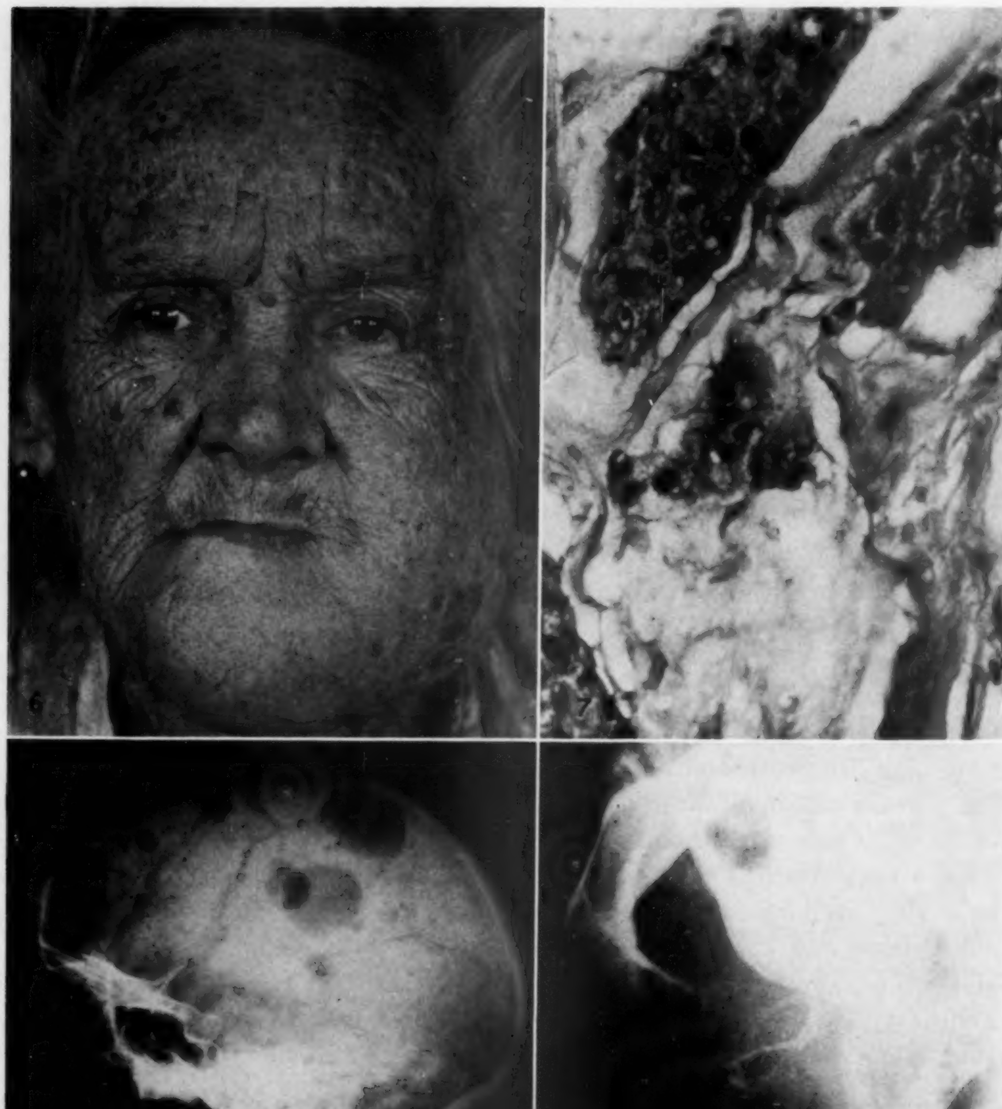


Fig. 6.—Case 3. Appearance of patient with metastatic carcinoma to the jaw (primary breast).

Fig. 7.—Case 3. Photomicrograph of tumor. Note mucin production. (High power.)

Fig. 8.—Case 3. Lateral view of skull showing destruction of bone.

Fig. 9.—Case 3. Oblique view of left mandible showing bone destruction with trabeculations.

After receiving 1,000 r. to the mandibular metastasis, the patient suddenly and absolutely refused to continue treatment and asked to be sent home. Nothing had been done for the breast lesion. The patient expired on April 17, 1943, and the autopsy showed a far-advanced carcinoma of the breast with mucoid degeneration which had metastasized to axillary lymph nodes, lung, mandible, and calvarium.

Comment.—This patient had a breast carcinoma of several years' duration. These mucoid carcinomas of the breast tend to grow rather slowly and form large bulky tumors. The metastasis to the jaw became very large and was present for over two years. Its cystic nature was probably caused by the production of mucin by the tumor, as demonstrated by the photomicrograph. These cystic changes could cause this metastatic lesion to be confused with an ameloblastoma. Invasion of the mandible by carcinoma, in or around the oral cavity, is fairly frequent. Metastasis to the mandible, on the other hand, is very rare in our experience, this being the only case in over 6,000 consecutive admissions.

Aspiration biopsy of the tumor mass of the mandible proved in this instance to be a satisfactory method of diagnosis. Interpretation of aspiration biopsies of mandibular lesions may be extremely difficult and a definite diagnosis should not be given unless adequate material is obtained for sectioning. Smearing of material obtained on slides distorts the tissue and we feel that this method is unsatisfactory. If the material obtained is inadequate or if the interpretation has to be based on only a few collections of cells which are poorly oriented, no diagnosis should be attempted.

IV. EPIDERMOID CARCINOMA OF THE LOWER LIP WITH REGIONAL METASTASES

Case 4, J. P., EFSCH No. 5471

Introduction.—Epidermoid carcinoma of the lower lip is a very common lesion among malignant tumors and microscopically is very well differentiated. It grows slowly, tends to remain localized, and metastasizes in only a small percentage of cases to the submental and submaxillary lymph nodes. The following case is an example of an advanced metastasis to a submaxillary lymph node.

This 76-year-old white man was first seen in the clinic in July, 1943, stating that a year previously he had had an operation for carcinoma of the lower lip. About two months previously, the patient noticed some small lumps beneath the left mandible, and, one month before, one of these "raised like a boil and broke." It did not clear up as previous boils had done but continued to grow. It was somewhat painful, slightly tender, and occasionally would extrude a small amount of foul, dirty blood. There had been a weight loss of about 12 pounds in the past year.

Examination revealed a red, fungating lesion 3.5 by 3.5 by 2 cm. attached to the ramus of the left mandible. There was a lymph node in the right submental region measuring 1 by 1 cm., and another of the same size fixed behind the angle of the right mandible (Fig. 10). There was a fullness in the left supraclavicular fossa suggestive of a mass. The patient was admitted for further study.

X-ray examination revealed a large soft-tissue tumefaction in the anterior left submental region. A shallow, concave, slightly irregular defect was noted in the inferior margin of the anterior left mandibular body. The central portion of the defect was immediately inferior to the mental foramen. (Fig. 11.)

The history and clinical evidence of this case indicated a resection of the left mandible and an upper neck dissection. Under endotracheal ether anesthesia, this was carried out on Aug. 7, 1943.

Gross Description.—The specimen consisted of the left mandible with attached tumor mass and overlying skin. The skin measured 8 by 5 cm. and in the center there was a ragged area of ulceration measuring 1.5 by 2.5 cm. In the immediate vicinity of this ulceration, there was obvious subcutaneous involvement by tumor. In the region of the submaxillary gland, there was a lymph node measuring 0.7 cm. which was questionably partially involved by carcinoma. A piece of muscle and fat was submitted separately, but no definite tumor could be seen grossly. The tumor was closely adherent to the mandible and seemed to be growing over a wide area on the exposed surface. It was invading muscle and had apparently invaded the inferior surface of the mandible. From the gross appearance of the specimen, the excision seemed questionably inadequate (Fig. 12). A radiograph of the mandible was taken. (Fig. 13.)

Microscopic Description.—The tumor was a well-differentiated epidermoid carcinoma. There was evidence of invasion of the skin, muscle, and bone of the mandible. It extended very close to the limits of excision and was growing in the loose tissues. Tumor was present in the submaxillary lymph nodes.

Microscopic Diagnosis.—Lymph node, submaxillary: Epidermoid carcinoma, Grade I, metastatic. Skin, mandible: Epidermoid carcinoma, Grade I, invasive. Bone, mandible: Epidermoid carcinoma, Grade I, invasive. Muscle: Epidermoid carcinoma, Grade I, invasive. The primary tumor arose from the oral cavity, lower lip. (Fig. 14.)

The postoperative course was satisfactory with exception of a small low-grade infection in the neck flap. The patient was discharged on August 30, and was asked to return in two months because of the danger of early local recurrence. This patient was last seen in February, 1944, at which time examination revealed a very good functional result with no evidence of local recurrence in the soft tissues of the resected side or of metastases in either side of the neck. The patient had grown a beard and it was difficult to see on which side the jaw had been resected. (Fig. 15.)

Comment.—Ten months after a V-excision for an epidermoid carcinoma of the lip, this patient developed a metastasis to the submaxillary lymph nodes. The chances of cure by x-ray therapy were very small, as the tumor had invaded the mandible. It was therefore thought that the radical operation performed might give the patient a reasonable chance of cure. Because of the patient's age and poor general condition, no attempt was made at the time of operation to dissect out the right submaxillary region or to do a total radical neck dissection on the left. By choice, however, a more radical procedure would have been preferred.

If the metastasis had occurred from a carcinoma of the tongue or the floor of the mouth, the operation would not have been attempted. These tumors

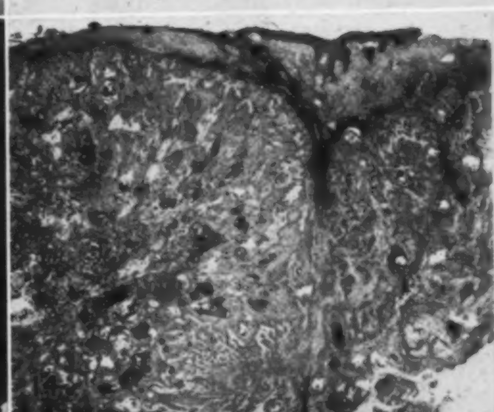


Fig. 10.—Case 4. Photograph of previously treated epidermoid carcinoma of lower lip with regional metastases.

Fig. 11.—Case 4. Oblique radiograph showing destruction in the inferior margin of the left mandibular body.

Fig. 12.—Case 4. Photograph of resected left mandible.

Fig. 13.—Case 4. Radiograph of resected left mandible.

Fig. 14.—Case 4. Photomicrograph of the tumor. Note deep invasion. (Very low power.)

Fig. 15.—Case 4. Photograph of patient seven months postoperative.

are usually quite undifferentiated, metastasize early, and may have distant metastases. The well-differentiated epidermoid carcinomas of the lower lip, when they metastasize, tend to remain local for long periods of time. In resecting the mandible for tumor, either benign or malignant, careful examination is made in the operating room, and the specimen is also usually sawed by a band saw in a sagittal plane to determine whether or not adequate excision has been made. This procedure was suggested by Dr. Sugarbaker. If, after this examination is made, excision is found to be inadequate, then further revision of the operation is still possible. We have also made it routine, as in this instance, to x-ray all surgical specimens of mandibles, after the soft tissues have been removed, thereby obtaining an excellent detailed study.

V. CARCINOMAS ARISING FROM THE GINGIVAE AND BUCCAL MUCOSA

Introduction to Cases 5, 6, 7, 8, and 9.—Carcinoma arising from the gingivae and at times from the buccal mucosa is fairly frequently quite well-differentiated and may at times present a verruca-like appearance, growing slowly, tending to invade contiguous structures, but metastasizing late. In this group of cases, surgery is at times indicated. The following group of five cases presents some of the variation encountered, and our methods of treatment.

Case 5, F. G., EFSCH No. 2701

This 70-year-old white woman was first seen in the clinic in April, 1941, complaining of a small "bump" on the lower left gingiva, first noted six months before. It had gradually increased in size and caused some pain on mastication. The patient complained of "neuralgia" on the entire left side of her head. There had been no bleeding or marked pain. A local physician had treated her for two weeks with medicine applied locally to the lesion. Snuff, held against the left buccal mucosa at the site of the present lesion, had been used for many years.

Examination of the mouth showed the left buccal mucosa, mandible, and left base of the tongue to be covered by a soft friable tumor mass. This mass was indurated, not ulcerated, and did not bleed. The left angle of the mandible was tender and enlarged. Just inferior to the mandible, attached to it but not to the skin, was a firm mass measuring 3 cm. in diameter.

X-ray showed a marked degree of bone destruction involving the posterior portion of the left mandibular body and the anterior inferior portion of the mandibular ramus. The margins of the defect were sharply defined and irregular in outline. There was only a narrow bridge of bone between the anterior and posterior regions of this mandible along its inferior border. (Fig. 16.) The patient was admitted for biopsy and x-ray studies.

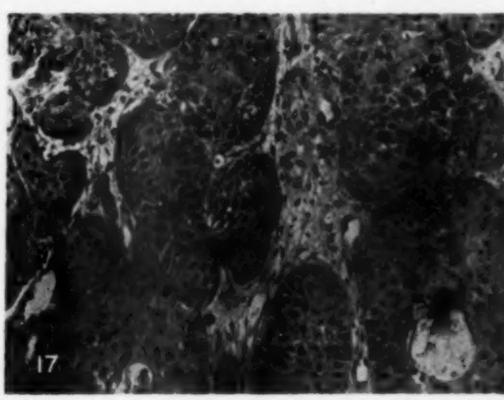
Gross Description.—The specimen consisted of a soft, grayish-white bit of tissue which on section was homogeneous grayish-white in color.

Microscopic Description.—There were masses of poorly differentiated squamous tumor cells present. In some areas, there was definite keratinization. Minimal chronic inflammation accompanied the tumor, which was apparently growing rapidly.

Microscopic Diagnosis.—Oral cavity, buccal mucosa: Epidermoid carcinoma, Grade II. (Fig. 17.)

A total of 2,000 r. units was given through two large fields to the right and left mandible from April 23 to May 10. Four months later the patient was apparently symptom-free, but six months later the tumor was obviously still present and growing within the substance of the mandible. After careful consideration, we concluded that this lesion could not be adequately removed surgically. Therefore, between Jan. 29 and Feb. 2, 1942, 1,800 mg. hours of radium irradiation was given to the left commissure of the mandible with the hope of healing the ulceration temporarily and relieving some of the pain.

Fig. 16.—Case 5. Oblique radiograph showing destruction of bone by invading carcinoma.



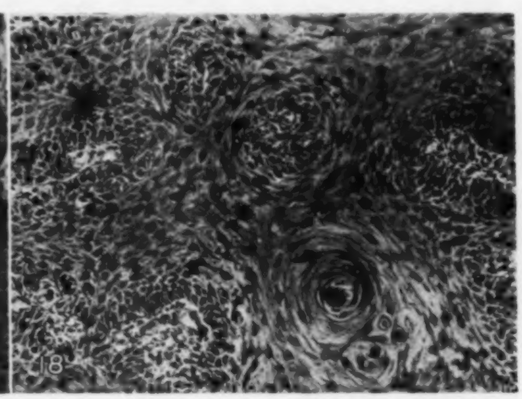


Fig. 17.—Case 5. Photomicrograph. Epidermoid carcinoma. (High power.)
Fig. 18.—Case 6. Photomicrograph. Epidermoid carcinoma. Note resemblance to Fig. 17. (High power.)

By March, 1942, all gross granular tumor had disappeared. There was a deep ulceration in the mandible from which there was a watery, purulent discharge. X-ray examination at this time revealed a moderate decrease in the size of the lesion, but a slight increase in the destructive bone changes along the alveolar portion of the anterior aspect of the mandibular body.

The patient was re-examined in May, 1942, at which time there was a mass of hard tissue fixed to the bone in the left submaxillary region. This was con-

tinuous with the tumor in the floor of the mouth and measured 2 by 4 cm. An oral fistula subsequently developed and the patient died on Dec. 1, 1942, twenty months after the first examination.

Comment.—In reviewing this case, x-ray therapy was of only slight palliative benefit. The only procedure which would have offered any chance of cure would have been radical resection of the mandible and adjacent tissues. In this instance, the patient had been seen by a physician who had treated her for two weeks by local application of medicine. The medical profession, as well as the dental profession, must refer at the earliest possible moment, for treatment, the patient who has a possible carcinoma of the oral cavity.

Case 6, M. G., EFSCH No. 3282

This 41-year-old white woman was first examined in the clinic in September, 1941. She had been accompanying her mother (patient in Case 5) to the hospital since April; and purely for her own information requested an examination of the left side of her mouth. She was a confirmed user of snuff and gave virtually the same history her mother had given. About six months before (this was approximately the same time we had diagnosed her mother's lesion as cancer of the mouth), a small whitish plaque in the left commissure of the mandible extending onto the cheek was noticed. The lesion, which slowly increased in size, had not been painful and had not bled.

Examination of the mouth showed the teeth to be in good repair, but the left buccal mucosa was covered with a white verrucous growth 3 by 5 cm. and elevated 4 mm. The upper fornix was free and the lower fornix and posterior recess was involved with this same ulcerating mass. Surrounding the elevated area in the left buccogingival gutter at the commissure of the mandible, was a zone of whitish leucoplakia. A biopsy of the buccal mucosa showed epidermoid carcinoma, Grade I.

The patient received a total of 3,000 r. units of x-ray through two fields to the right and left mandible, and on her discharge on Oct. 14, 1941, there was considerable regression of the lesion, although the radiation reaction was severe. Re-examination three months later revealed an ulcerated area of the buccal mucosa just lateral to the angle of the left mandible with evidence of persistent tumor. In view of the previous radiation, further treatment in all probability would have resulted in radionecrosis.

On Jan. 16, 1942, under endotracheal anesthesia, the body and ramus of the left mandible were resected.

Gross Description.—The entire left mandible, sectioned at the symphysis, together with adjacent soft tissue, was submitted. Overlying the bone of the mandible, there was an ulceration measuring 2.5 by 2 by 1 cm. This ulceration did not extend into the bone.

Microscopic Description.—There was evidence of necrosis, fibrosis, and chronic inflammation. One section showed residual well-differentiated epidermoid carcinoma which was actively growing. The bone of the mandible was free from tumor but did show evidence of radiation effect.

Microscopic Diagnosis.—Oral cavity, buccal mucosa: Epidermoid carcinoma, Grade I (Fig. 18); radiation reaction. Bone, mandible: Radiation reaction.

The postoperative course was complicated by the development of a fistula with sloughing inside the mouth, but the patient slowly improved and was discharged on March 8. Two months later, two sinuses surrounded by tissue which looked suspiciously like tumor were noted in the anterior portion of the neck scar. Inside the mouth, there was a great deal of slough and granular tissue which looked like persistent tumor. Biopsy of this lesion showed no evidence of recurrent disease. There were no palpable neck nodes or other oral primaries. She was last seen in October, 1943, and there was no change from the previous examination.

Comment.—This patient developed carcinoma in approximately the same location and under the same circumstances as her mother. It occurred at the age of 41 years, which is earlier than the usual age of occurrence. She carried a wad of snuff against the buccal mucosa where the tumor developed. This is somewhat comparable to the slowly developing betel nut carcinomas, which appear on the buccal mucosa opposite the molars and premolars where ordinarily the quid is carried.[12, 13] Although this tumor failed to respond to adequate x-ray therapy, resection of the mandible offered an excellent chance of cure. It is probable that genetic factors did not play any significant role in production of carcinoma in this case. The fact that both the mother and daughter used snuff makes it more likely that this was the common etiological factor in both cases.

Case 7, W. B., EFSCH No. 5430

This 78-year-old white man was first seen in the clinic in July, 1943. A year before, a sore spot had appeared on the upper gingiva where his denture rubbed. This had gradually increased in size, and six weeks before our first examination the patient consulted his local physician who told him it was cancer. The patient said that within the last two months the spot had grown rapidly in size and had given a lot of pain which radiated up to the left temporal region. He had been unable to eat any solid foods and because of the pain could not open his mouth very wide.

Examination revealed an extensive exophytic tumor of the left buccal mucosa measuring about 4 by 5 cm. in diameter. It extended from the upper alveolar ridge down to the lower gingival buccal gutter and involved the left anterior pillar. The patient was admitted for complete study. (Fig. 19.)

Radiotherapy has been of questionable value in these cases, and for that reason radical resection seemed indicated. On Aug. 3, 1943, under endotracheal ether anesthesia, resection of the left mandible, buccal mucosa, and the alveolar crest of the tuberosity of the maxilla was performed.

Gross Description.—The specimen consisted of a portion of the left mandible measuring 8 cm. in length. The coronoid process was present but the mandible had been sectioned just below its head. The masseter muscle, a portion of the buccinator muscle, submaxillary gland, and a few small lymph nodes appeared normal. The inferior border of the maxilla was apparently unin-



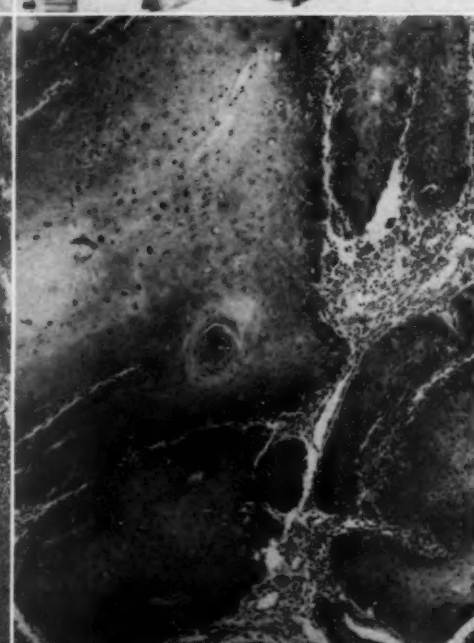



Fig. 19.—Case 7. Intraoral view showing verrucous type of carcinoma of the buccal mucosa and left maxillary and mandibular alveolar ridges.

Fig. 20.—Case 7. Photograph of surgical specimen.

Fig. 21.—Case 7. Photomicrograph. Note deep invasion. (Very low power.)

Fig. 22.—Case 7. Photomicrograph. Note disorderly pattern. (High power.)

volved by tumor. On the surface of the buccal mucosa, polypoid, soft piled-up masses of tumor, apparently representing early carcinoma, were seen. On section of the tumor it was markedly piled up but did not invade the bone. (Fig. 20.)

Microscopic Description.—The epithelium was markedly thickened, hyperplastic, and showed prolongation of its rete pegs. Mitotic figures were fairly frequent. The basement membrane was intact and inflammation was prominent. (Figs. 21 and 22.)

Microscopic Diagnosis.—Oral cavity, buccal mucosa: Epidermoid carcinoma, Grade I.

The patient was last seen in February, 1944, at which time there was no evidence of local recurrence.

Comment.—This is an example of fairly early verruca-like epidermoid carcinoma of the buccal mucosa which, in all probability, eventually would have invaded the bone. (See Case 8.) The tumor had a duration of at least a year, and with such an extensive process, it was felt that radical resection was the procedure of choice. We expect that the prognosis and the cosmetic result will be good. The irritation of the denture appears to have been an important factor in stimulating this neoplasm. The value of careful, periodic examination even in the edentulous mouth is evident.

Case 8, J. G., EFSCH No. 5986

This 58-year-old white man was first seen in the clinic on Jan. 12, 1944. He gave a history of having had some teeth extracted in the left lower jaw in September, 1943. Following the extractions, the jaw remained swollen and discharged some blood and pus. One month following the extractions, the swollen jaw began to drain on the outside through the cheek. He stated that this process had been entirely painless.

Examination revealed a fungating and somewhat leucoplakic ulcerated lesion extending from just left of the midline of the lower alveolus posteriorly to the molar region at the junction of the horizontal and vertical rami. It extended into the substance of the cheek, and on the skin surface presented a 1 cm. fistula. The mandible was considerably widened but there were no palpable neck nodes. (Figs. 23 and 24.) The patient was admitted for study.

X-ray examination revealed a large, sharply defined defect involving the greater portion of the left mandibular body. The destruction extended posteriorly to the angle and rarefaction was present anteriorly, beyond the region of the mental foramen. (Fig. 25.)

On Feb. 1, 1944, under endotracheal ether anesthesia, resection of the left mandible and upper neck dissection were performed. Because the ulcerating lesion over the mandible was so friable and bled so freely, a preliminary ligation of the lingual artery was made through a separate incision. The first incision in the mouth excised the lesion, leaving about a 1 cm. margin on all sides. Anteriorly this incision was carried forward in a linear fashion to a point just past the symphysis of the mandible. After this incision had been made, the fascial plane medial to the mylohyoid muscle was identified and developed

down to the level of the hyoid bone. Externally a second incision was made in an elliptical fashion so that the involved skin was excised. An ellipse in the excision was carried out posteriorly to a point just below and anterior to the mastoid process. This incision was carried down through the deep fascia, and the attachment of the mylohyoid muscle at the hyoid bone was severed. At this point, the external maxillary artery was ligated a short distance from the common carotid, and the entire contents of the upper neck, the overlying skin, and the tumor mass still attached to the jaw was thus excised en bloc. The jaw was divided, using a Gigli saw at the level of the symphysis, and by blunt and sharp dissection the attachments of the masseter muscle and internal and external pterygoid were stripped from the mandible. The attachment of the temporal muscle to the coronoid process was severed and the left mandible disarticulated at the temporomandibular joint. Buccal mucosa was approximated to the mucosa which remained on the floor of the mouth adjacent to the tongue, using a running catgut suture which inverted the mucous membrane. This suture line was reinforced by a second interrupted row of catgut sutures. The wound was closed with interrupted catgut sutures to deeper structures and inverted mattress type silk sutures to the skin. A drain was placed in the pterygoid fossa and the region of the parotid gland.

Gross Description.—The specimen consisted of the entire left mandible, the overlying skin and the contents of the left submaxillary and submental spaces. The skin had been excised in a somewhat elliptical form and measured 10 by 5 cm. In its central portion, there was an ulcerated area measuring 2 by 0.6 cm., its edges apparently made up of friable tumor tissue. A cauliflower-like, fungating, meaty tumor mass involved almost the entire area of excised gingiva, and extended well up on the ramus. It measured 5.5 by 3 cm. and grossly extended to within 1.3 cm. of the point of division of the mandible at the symphysis. The tumor was obviously invading bone and was extending out into the left submaxillary and submental areas. The tumor surrounded, but did not invade, the submaxillary gland. (Fig. 26.)

Microscopic Description.—The tumor was a very well-differentiated epidermoid carcinoma and was accompanied by variable amounts of connective tissue in varying degrees of inflammation. Apparently, there was an adequate margin of excision. There was no evidence of tumor in any of the lymph nodes.

Microscopic Diagnosis.—Oral cavity, buccal mucosa: epidermoid carcinoma, Grade I. Bone, mandible: Epidermoid carcinoma, Grade I, invasive. Lymph nodes, submaxillary: Hyperplasia.

The postoperative course was uneventful and the wound healed nicely in spite of the fact that infected tissue had been cut at the time of operation. The patient was discharged in good condition.

Comment.—The tumor, a well-differentiated epidermoid carcinoma, began on the gingiva, spread laterally, invaded the mandible, grew through the skin, and caused ulceration. Like some other tumors seen in this region, and like some of the other cases reported here, it locally invaded contiguous structures including bone, but failed to metastasize to any lymph nodes. Because of the extensiveness of the tumor and its well-differentiated character, wide surgical excision

was the method of choice for treatment. X-ray therapy would undoubtedly have failed, and if carried to any considerable dosage, the effects of the radiation on the tissue surrounding the tumor would have made subsequent operation, such as the one done here, difficult, if not impossible. If this had been a relatively undifferentiated epidermoid carcinoma, the operation would not have been justified and the patient would then have received x-ray therapy. This patient probably had an epidermoid carcinoma at the time of his dental operation and x-ray examination at that time might have shown the destructive process.

Fig. 23.—Case 8. Intraoral view showing verrucous type of carcinoma of left mandibular alveolar ridge.

Fig. 24.—Case 8. Extraoral photograph showing fistulous opening.

Fig. 25.—Case 8. Oblique radiograph of left mandible showing loss of bone.

Fig. 26.—Case 8. Radiographic view of operative specimen.

Case 9, M. L., EFSCH No. 5797

This 72-year-old white man was first seen in the clinic on Nov. 4, 1943. About a year and a half before, a hard spot on the labial gingival surface of the left mandible was first noted. This mass grew slowly in all directions and nine months previous to our examination it had grown up over the gingiva, and,

shortly after, there was a slight deformity in the contour of the left side of the face. There had been no pain, and bleeding occurred only during eating. The teeth had been extracted twelve years before. One month before admission, there was limitation in opening the jaw and the patient consulted his family physician, who referred him to this hospital.

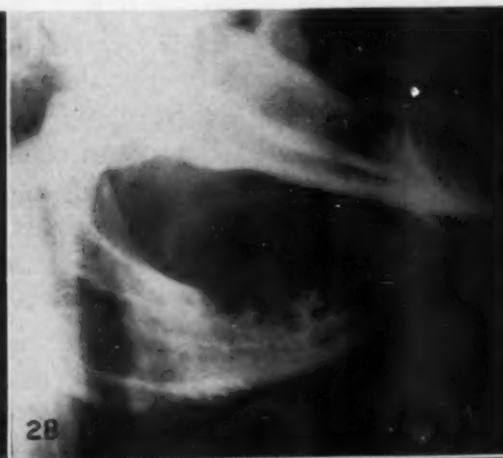
Examination of the mouth revealed the entire left gingiva of the mandible from the midline in front to the commissure to be invaded by tumor tissue. The mass was visible externally, deforming the jaw. It was very hard, slightly tender, but showed no ulceration and measured 6 by 4 by 3 cm. There were no other symptoms relative to tumor. The patient was admitted for further investigation. (Fig. 27.)

X-ray examination of the jaw revealed the mouth to be edentulous. There was a moderate amount of bone destruction which extended inferiorly to the mandibular canal and involved the alveolar ridge of the mandibular body. The margins were irregular and sharply defined. (Fig. 28.)

The clinical examination and history of this patient suggested a highly differentiated squamous carcinoma which has a tendency to invade contiguous structures, including bone. The biopsies taken showed merely hyperkeratinization, hyperplasia, and chronic inflammation. The basement membrane had remained intact and there were only a few mitotic figures seen. A resection of the jaw seemed to offer the best prognosis.

On November 9, under endotracheal ether anesthesia, an incision was made in the mucous membrane encircling the lesion and leaving a 1 cm. margin. Externally the incision was made parallel to the lower portion of the mandibular ramus and an elliptical area of skin which seemed to be involved by carcinoma was excised. The incisions were deepened down inside the mouth until a finger could be placed in the section plane between the geniohyoid and the mylohyoid muscles. This was opened with blunt dissection from the mid-point medially to the angle of the jaw posteriorly. The external incision was carried down through the platysma to expose the origin of the mylohyoid muscle which was then severed, exposing the digastric muscle beneath it. The mandible was severed in the midline with a Gigli saw. The posterior attachment of the jaw was then resected, the internal and external pterygoids cut, the articulation of the mandible exposed, and the temporalis muscle removed from it. The condyloid process of the mandible was then cut through and the specimen removed. The mucous membrane was closed with interrupted catgut. The portions of the muscles surrounding the structures which had been left and which were viable were pressed into the wound, and the skin was closed in routine fashion with interrupted silk. A drain was placed in the internal pterygoid fossa medially, being brought out through a stab wound in the lower angle of the wound. A pressure dressing was applied after sulfanilamide had been dusted into the cavity previously irrigated with saline.

Gross Description.—The specimen consisted of the right half of the mandible sectioned at the symphysis. The condyloid process was missing. Attached to the entire horizontal ramus on its medial aspect was a 5 by 5 cm. papillomatous, verruca-like lesion, questionably fixed to bone. About 0.5 cm. of normal mucous



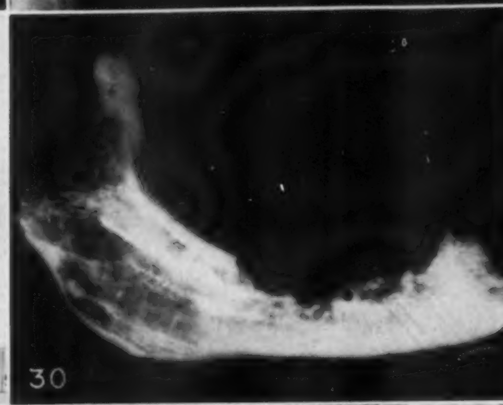


Fig. 27.—Case 9. Intraoral view showing verrucous carcinoma of left mandibular alveolar ridge.

Fig. 28.—Case 9. Oblique radiograph showing destruction of bone.

Fig. 29.—Case 9. Photograph of operative specimen.

Fig. 30.—Case 9. Radiograph of operative specimen.

Fig. 31.—Case 9. Photomicrograph. Note tumor invading bone.

membrane surrounded this lesion. Removed with the mandible was an irregular ellipse of skin measuring 10 by 5 cm. which was also fixed to the underlying mass. The submaxillary salivary gland and lymph nodes grossly were free from tumor. Two separate pieces of tissue from the limits of the excision were also submitted. Grossly this tumor apparently invaded the mandible and questionably the muscle. (Figs. 29 and 30.)

Microscopic Description.—This tumor was a very well-differentiated epidermoid carcinoma with marked piling up of the epithelium and with deep extension of fingers of tumor into underlying mandible and contiguous muscles. The tumor was accompanied by marked desmoplastic reaction and chronic inflammation. The submaxillary gland showed evidence of minimal chronic inflammation but no tumor. All regional lymph nodes were negative. (Fig. 31.)

Microscopic Diagnosis.—Oral cavity, buccal mucosa: Epidermoid carcinoma, Grade I. Bone, mandible: Epidermoid carcinoma, invasive.

The wound healed per primam and the postoperative course was excellent. A drug fever from sulfathiazole developed and also an epididymitis which responded well to x-ray therapy. The patient was discharged on December 3.

Comment.—This is a good illustration of a slowly-growing verrucous type of epidermoid carcinoma which gradually invaded mandible and contiguous muscle. This is an advanced lesion, for which radiotherapy would have been of only questionable palliative benefit. Surgery gives this patient an excellent chance of cure, but it would have been made much more difficult by previous x-ray therapy. This neoplasm developed slowly in an edentulous mouth. Treatment could have been instituted about a year and a half earlier if the mouth had been examined by a competent dentist.

VI. PRIMARY CYSTIC TUMORS OF THE MANDIBLE

Introduction to Cases 10 and 11.—Cystic tumors of the mandible, even when primary, may present difficulties in their diagnosis and treatment. Unusual variation may occur, and the group of tumors spoken of as ameloblastomas are of particular interest. These tumors may be mistaken for developmental cysts of the jaw, including those of dental origin (periodontal, dentigerous, and so-called follicular cysts) and those of nondental origin (median, palatal, incisive canal and globulomaxillary cysts) (see Cases 17 and 18).

Case 10, M. B., EFSCH No. 5422

This 47-year-old white woman was first seen in the clinic in July, 1943. Eight years before, a swelling on the gingiva surrounding the right lower first premolar was noticed. The patient consulted her dentist, who extracted the tooth, but the swelling persisted and slowly increased in size, although it gave no pain. In August, she again consulted her dentist, who extracted two more teeth in the right lower jaw. Immediately following these extractions, she consulted her local physician and he incised the original swelling, obtaining a small amount of pus. The patient became alarmed, sought consultation elsewhere, and was referred to this hospital.

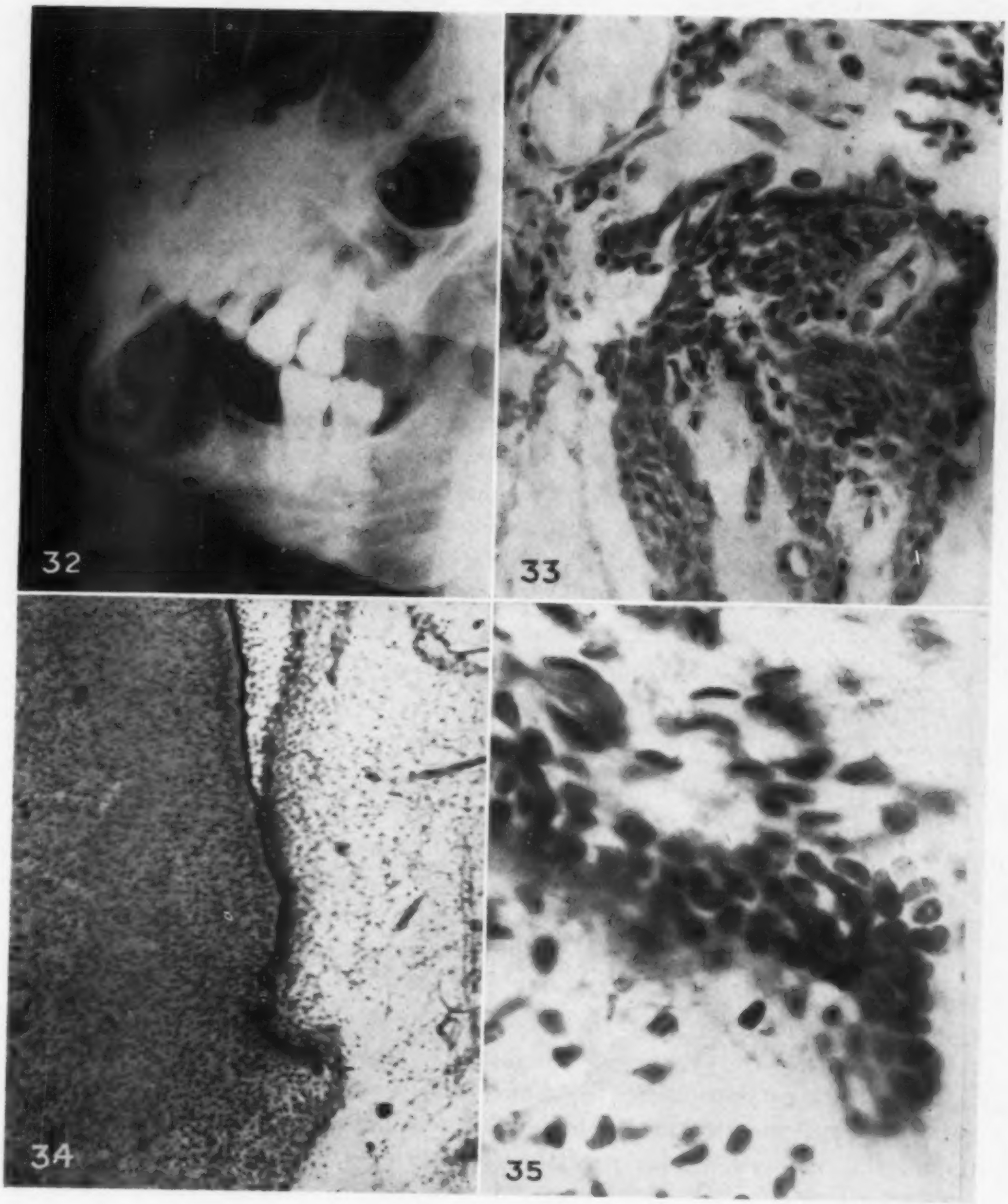


Fig. 32.—Case 10. Radiograph of right mandible showing circumscribed radiolucent area produced by cystic tumor.

Fig. 33.—Case 10. Photomicrograph showing columns of epithelial cells resembling sheath of Hertwig (high power).

Fig. 34.—Case 10. Photomicrograph of sheath of Hertwig at base of normal enamel organ (low power).

Fig. 35.—Case 10. Photomicrograph of area indicated by arrow in Fig. 34 (high power).

Intraoral examination revealed a mass 4 by 3 by 3 cm., centered at the site of removal of the right lower canine and first premolar. It was bony hard with an overlying layer of connective tissue and was palpable externally as a deformity in the jaw. The canine, two premolars, and first molar of the lower right jaw were missing. The remaining teeth were in fairly good condition. The patient was admitted for study.

X-ray examination revealed a large tumefaction extending outward and slightly upward from the anterior portion of the right mandibular body and mandibular symphysis. Posteriorly, the lesion extended to the anterior portion of the root socket area of the first molar. Anteriorly, the lesion extended left laterally beyond the symphysis. The greatest volume of the tumefaction was in the canine and premolar areas. The central portion of the lesion presented a diminished density with a loss of architecture. About the inferior and posterior aspects and bordering the rarefied zone was a broad margin of spotted increased density. The inferior and mesial border of the mandible was normal at the site of the tumor. (Fig. 32.) Aspiration biopsy was insufficient for definite diagnosis. A few scattered nests of epithelial cells arranged in questionable acini were seen in this biopsy. They apparently came from the cystic area. The absence of disease elsewhere, the x-ray picture, and the histology of the aspiration biopsy suggested very strongly an ameloblastoma, and for that reason a jaw resection was performed on Aug. 11, 1943.

Under endotracheal ether anesthesia, a bovie knife incision was made in the gutter of the mucous membrane of the right side of the mouth. This was extended from the angle of the jaw to the midline. A finger was placed in this incision and the cleavage plane between the mylohyoid and the contents of the submaxillary triangle was opened. An incision was then made externally through the skin and a large amount of subcutaneous fat down through the platysma, removing the digastric and mylohyoid muscle on this side. The jaw was then sawed with a Gigli saw in the midline, the skin being protected. The skin of the side of the face was then removed from the bone of the jaw to the angle of the mandible. The masseter, both of the pterygoid muscles, and the temporalis muscle were cut. The condyloid process of the mandible was disarticulated and the specimen removed. With the cutting of the posterior attachment, a brisk amount of bleeding was encountered. This was controlled with clamping and ligating. Four grams of sulfanilamide were placed in the wound and the mucous membrane was closed with catgut. A drain was brought out by stab wound inferiorly, one end of it leading into the site of removal, the other where the disarticulation had taken place. The left teeth were brought into occlusion and wired together. A pressure dressing was applied and the patient was returned to the ward in good condition. Sectioning of the mandible at the time of operation showed the excision to be adequate on gross examination.

Gross Description.—The specimen consisted of the right mandible, which was sectioned at the symphysis. There was a fairly symmetrical swelling at the proximal portion. The mandible had been sectioned by a band saw in a sagittal plane. In the substance of the mandible there was a soft area which measured

from 1 to 1.5 cm. in width. It was surrounded by dense connective tissue and bone and extended fairly close in some areas to the limits of the cortical bone. The margin of normal bone at the symphysis varied from 4 to 7 mm. A submaxillary lymph node appeared normal.

Microscopic Description.—Nests of pale blue-staining tumor cells with fine nucleoli were seen. At times they took on a pseudoglandular appearance. In many areas there was a heavy infiltration of plasma cells surrounding the tumor. There was also bone production and marked desmoplastic reaction. This did not appear to be an ameloblastoma. It was compatible with tumor having its origin in epithelial remnants of the sheath of Hertwig.

Microscopic Diagnosis.—Benign tumor (sheath of Hertwig origin). (Figs. 33, 34, and 35.)

This patient was last seen in January, 1944, at which time there was no evidence of local recurrence. The cosmetic result was good and the dental occlusion on the left was excellent. The prognosis seemed very good.

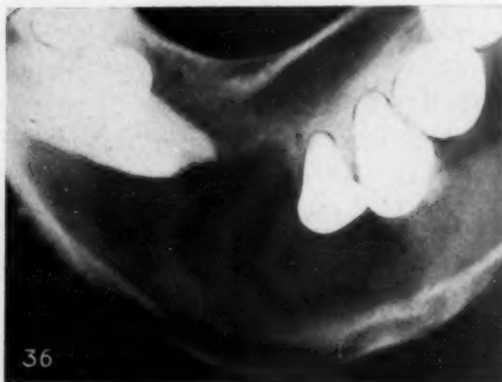
Comment.—The uncertain nature of this tumor made the handling of this case rather difficult. Material obtained from the aspiration biopsies before resection, plus the x-ray examination, made this tumor very suggestive of ameloblastoma. Certainly it was a tumor primary within the bone and not metastatic. It produced marked bone and connective tissue formation which, together with its cystic central portion, gave a picture in the x-ray of a cystic zone surrounded by an area of markedly increased density. This tumor is of dental origin and whether it is related to an ameloblastoma is a debatable point. Epithelial remnants of the sheath of Hertwig are present in teeth of patients of this age. A tentative diagnosis of a benign tumor arising from the sheath of Hertwig is strongly suggested by the evidence presented. From the histologic picture, one would not expect this tumor to metastasize, but the radical operation which was performed seemed a logical procedure in view of the pathologic findings. The paradental debris of Malassez is present around practically all teeth regardless of age. Careful studies of dental granulomas have shown epithelium present in the proliferating granulation tissue or in the contiguous connective tissue tags in 100 per cent of those examined by serial section. In 41 per cent of these, the epithelium was proliferating.[14] Extraction of teeth without removal of all the granulation tissue or tissue of a periodontal cyst may result in continued epithelial proliferation between the bone trabeculae. These benign growths defy enucleation and often present histories of repeated recurrence. Although they are obviously benign, the operation of choice is usually resection.

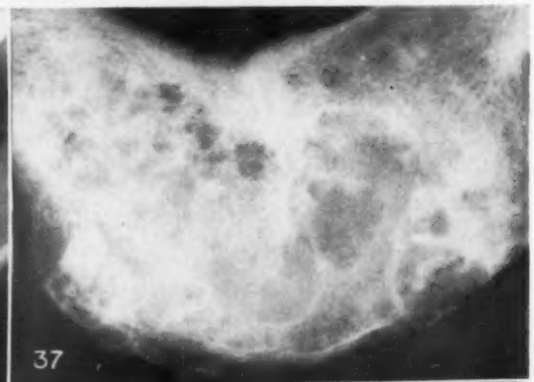
Case 11, Ameloblastoma

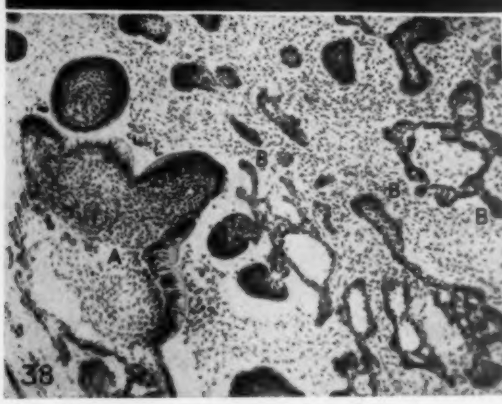
Because the ameloblastoma (adamantinoma, adamantinoblastoma) is the only true neoplasm of the dental apparatus and because it presents such clinical, histological, and radiographical variations, this case is a composite picture developed from the statistical, clinical, and laboratory studies of this tumor.

The average age of the patients at presentation is about 37 years, and the tumor usually has been present for some seven or eight years. On this basis, we may conclude that the lesion appears on the average in the late twenties or

early thirties. The distribution between the sexes is not significant. The lesion appears more frequently in the mandible (84 per cent) than in the maxilla (16 per cent). In 160 cases of ameloblastoma of the mandible collected by Robinson[16] 52 per cent were on the left side, 41 per cent on the right, and 7.5 per cent in the region of the symphysis. In 33 maxillary cases, 51 per cent were on the left, 36 per cent on the right, and 12 per cent in the anterior area.







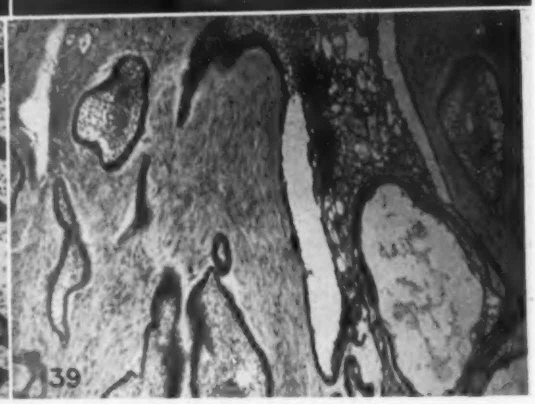


Fig. 36.—Case 11. Radiograph of chronologically young solid ameloblastoma.

Fig. 37.—Case 11. Radiograph of cystic ameloblastoma of 65-year-old patient. Known duration, ten years.

Fig. 38.—Case 11. Photomicrograph showing enamel-organlike structure at *A* and strands resembling dental laminae.

Fig. 39.—Case 11. Photomicrograph of cystic ameloblastoma with degeneration of central stellate cells.

Radiographically the lesion may vary from a radiolucent area a few centimeters in diameter to one which has expanded the entire mandible or maxilla. The borders are usually lobulated or scalloped due to the multiple centers of growth and irregular expansion in medullary spaces of different sites and resistances. The solid, younger ameloblastoma probably will not show trabeculations (Fig. 36). As the tumor grows, the jaw is expanded, the teeth possibly displaced and a more multicystic appearance is evident. The bone may appear honeycombed by numerous large and small spaces separated by trabeculae. (Fig. 37.)

Microscopically, in a young solid ameloblastoma the tissue shows epithelial growth in a connective tissue stroma of mesenchymal cell type. The epithelium grows in strands and nests, resembling the dental lamina or the enamel

organ up to the point of function (Fig. 38). At the functional point, the follicles break down at the expense of the stellate central cells and the typical multilocular cyst results.[15, 17] (Fig. 39.)

The ameloblastoma commonly recurs after enucleation because the follicles and strands of epithelium which have grown between bone trabeculae are not readily dislodged. Except in the early firm stage, operative resection is the treatment of choice. Although this tumor is not usually malignant (somewhat less than 5 per cent of the cases in the literature appear malignant by one set of criteria or another), authentic cases of metastases have been reported.

On the basis of the above information, a typical case might be in a 37-year-old man or woman who first noted a swelling on the left side of the mandible seven or eight years earlier. At the time of the first examination at the age of 29 or 30 years, the radiographic picture was probably similar to that seen in Fig. 36 and the microscopic appearance like that in Fig. 38. After several enucleations and aspirations, the patient would come to the hospital with a distended alveolar ridge in the mandible and resultant deformity of the lower face. The mass would be firmly attached to the bone and probably lobulated with some areas that were fluctuant. The radiographic picture would likely be similar to Fig. 37 and microscopically like Fig. 39. The operation of choice would be resection of the mandible. Even if the tumor were seen at an earlier stage, this should be done, because after inadequate operative therapy, recurrences are the rule rather than the exception.

VII. MIXED TUMORS OF THE SUBMAXILLARY GLAND AND ORAL CAVITY

Introduction to Cases 12, 13, 14, and 15.—Salivary gland mixed tumors are rather infrequent in our hospital. We have had 30 to date, with 19 of the parotid, 5 of the hard and soft palate, 4 of the submaxillary gland, one of the buccal mucosa, and one of the lip. The tumors arising from the hard and soft palate, combined, are just as numerous as those of the submaxillary gland. These thirty salivary gland tumors occurred in over 10,000 surgical specimens, and it must be emphasized that every biopsy submitted to the pathology department was from a tumor or suspected tumor. In Ahlbom's series[18] of 254 salivary gland tumors, the ratio between parotid and submaxillary gland mixed tumors was about 14 to 1. The number of tumors arising from hard palate, alveolar ridge, and soft palate were about equal to the number found in the submaxillary gland. The salivary glands of the oral cavity are very numerous and have been very adequately described by Cheyne in Orban's[19] text. Mixed tumors can arise in any area where these glands occur.

Case 12, C. C., EFSCH No. 4935

This 49-year-old white male was first seen in the clinic in January, 1943. A small nodule had been present beneath the right mandible in the region of the right submaxillary gland for ten years. This nodule had slowly increased in size, and during the past year had become quite painful, the pain radiating along the second branch of the fifth nerve in the preauricular area. Ten

years previously, some teeth had been extracted from the posterior right jaw. There had been frequent headaches, especially in the mornings, which the patient said seemed to come from the right jaw.

Examination showed a definitely tender, hard, noncrepitant mass, easily visible and causing slight asymmetry of the right face. The mass was definitely attached to, and appeared to be part of, the mandible itself. There were no isolated nodes palpable. The oral cavity showed no ulceration of the mucosa overlying the right posterior alveolar ridge, but the same swelling could be felt. The patient was admitted for study.

X-ray examination revealed a large soft-tissue tumefaction in the submaxillary region immediately anterior to the mandibular angle. Atrophic changes were present along the inferior margin of the posterior aspect of the mandibular body. A fairly well-defined zone of structural bone loss was noted in the angle and adjacent portion of the body. The mandible was edentulous. (Fig. 40.)

Two aspiration biopsies of the nodule in the angle of the right mandible failed to secure enough material to make a diagnosis, and before further diagnostic measures could be taken, the patient left the hospital against advice. He returned to the clinic in July, 1943, and examination showed no change. Biopsy showed a malignant mixed tumor of the submaxillary salivary gland. The patient again left the hospital against advice, but returned in August. He stated that, three days before, he began to spit up blood. Examination now revealed a swelling in the right side of the nasopharynx, but no ulceration was seen. During the examination there was a great amount of hemorrhage produced, and there seemed to be some obstruction to the left nasal passage. The mass at the angle of the right jaw had remained approximately the same size and consistency.

On August 16, under endotracheal ether, a right jaw resection followed by a tracheotomy was done. At operation, an elliptical incision was made in the skin over the tumor, allowing a 2 cm. margin. In the medial portion, this was deepened to the full thickness of the musculature underlying it and an opening was made above and below the mandible into the oral cavity. An incision was made in the mucous membrane of the oral cavity over the internal inferior margin of the mandible. A Gigli saw was placed around the mandible at its medial portion and the mandible was sawed through and retracted upward. The anterior belly of the digastric muscle on this side was exposed, and using this as a guide, the entire contents of the submaxillary triangle were removed, taking the digastric muscle and leaving the mylohyoid as a base. The facial artery and vein were seen and ligated after they had been clamped and tied. The glossopharyngeal nerve was seen and spared. Dissection was continued upward, cutting the posterior belly of the digastric and stylohyoid muscles, but leaving their origins on the styloid process intact. Dissection was carried up to the masseters and pterygoids, which were cut, and the mandible to the coronoid process was freed. Similar dissection was carried up on the internal surface of the mandible through the incision in the mucous membrane until the

mandible was freed in this area. The insertion of the temporalis muscle into the coronoid process was severed and the posterior articulating facet of the mandible sawed through, thereby allowing removal of the specimen. Hemostasis was obtained and sulfanilamide placed in the wound. The skin wound was closed with interrupted silk stitches, the mucous membrane closed with interrupted catgut, and a pressure dressing was applied. At this point, respiratory efforts were moderately strenuous and a routine low tracheotomy was done.

Fig. 40.—Case 12. Oblique radiograph showing destruction of bone by mixed tumor.
Fig. 41.—Case 12. Photograph of operative specimen. Note invasion of mandible.
Fig. 42.—Case 12. Radiograph of operative specimen.
Fig. 43.—Case 12. Photomicrograph. Malignant mixed tumor. (Low power.)

Drains were inserted in the lower angle of the wound, and the patient was returned to the ward in good condition.

Gross Description.—The entire right mandible, together with an elliptical piece of skin and contents of the submaxillary triangle, was submitted. The skin measured 11 cm. in length, and at its widest portion measured 3 cm. It

was apparently attached in its midportion to the underlying mass. After the tumor was dissected free from the mandible, grayish-white firm tissue could be seen infiltrating it. The mandible was obviously replaced by tumor in its inferior two-thirds over a distance of 4.5 cm. There was a margin of apparently normal bone measuring 2 cm. at the symphysis. The mass seemed to arise from the submaxillary gland. It was firm and almost cartilaginous in consistency and grayish-white in color with small yellowish areas of questionable mucoid degeneration. The tumor was invading the contiguous muscle, but all lymph nodes grossly were negative. Tissue was also taken from the limits of the excision near the base of the tongue. The specimen was tagged at the points where the surgical resection was closest to the tumor. (Figs. 41 and 42.)

Microscopic Description.—This was a typical mixed tumor which had invaded muscle and mandible and was present within the perineural lymphatics in a few areas. The tissue from the base of the tongue showed no evidence of tumor and the sections taken from the regions tagged showed a narrow margin of adequate excision. This tumor replaced the muscle and the bone of the mandible. There was apparently an adequate margin of safety in the resected mandible. The lymph nodes were negative. (Fig. 43.)

Microscopic Diagnosis.—Malignant mixed tumor of the submaxillary salivary glands, with invasion of muscle and bone of the mandible.

The patient was discharged from the hospital on August 30, with instructions to continue irrigations of the operative defect. He was last seen in November, 1943, at which time he stated that he had been in good health, was gaining weight, and was delighted with both functional and cosmetic results. Careful palpation inside the mouth along the base of the tongue and pharyngeal fossa, as well as in the neighborhood of the pterygoid fossa, failed to reveal any evidence of local recurrence. No neck nodes were palpable.

Comment.—The long history and the location of the tumor warranted the clinical diagnosis of a mixed tumor. The tumors of the oral cavity which can metastasize to the submaxillary lymph nodes originate from the tongue, lower lip, floor of the mouth, upper and lower alveolar ridge and from carcinomas of the antrum which have ulcerated into the oral cavity. Examination of the oral cavity ruled out these areas as a source of the tumor in the submaxillary region. Aspiration of the tumor showed tissue compatible with the diagnosis of a mixed tumor of salivary gland origin. The radical operation performed was the only one which offered any chance of cure. These tumors are locally invasive as evidenced by the involvement of muscle and bone. They infrequently metastasize to lymph nodes. Local recurrence after many years can occur, and the only chance of preventing this is by initial radical operation. The involvement of the mandible by mixed tumors of the submaxillary salivary gland is a rare occurrence. This tumor was classified as malignant on the basis of muscle and bone invasion. The prognosis for cure should be fair.

Case 13, S. D., EFSCH No. 3245

This 71-year-old white woman was first seen in the clinic in September, 1941. Five years before, a small tumor was first noticed in the right side of

the roof of the mouth. The lesion slowly increased in size and because of this the patient had not been able to wear her upper dentures for the past three years. It had never bled and had never been painful.

Examination of the roof of the mouth on the right revealed a firm, rounded tumor mass with a smooth gray surface measuring about 4 by 4 by 2 cm. It was not ulcerated. (Fig. 44.) No other symptoms or signs relative to tumor were present. The patient was admitted for diagnosis and treatment.

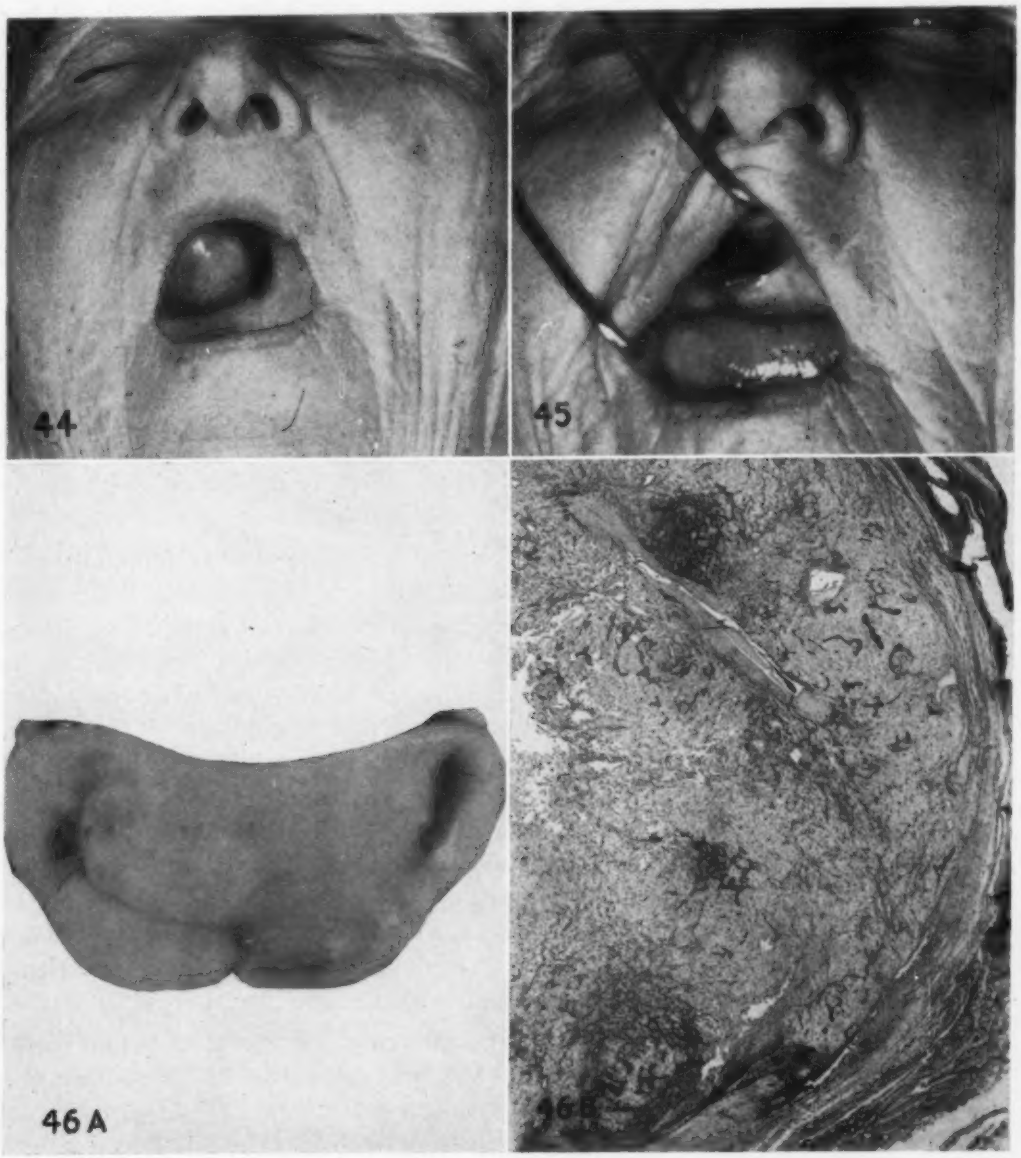


Fig. 44.—Case 13. Intraoral view showing mixed tumor of right hard palate.
Fig. 45.—Case 13. Photograph showing defect in hard palate.
Fig. 46*A*.—Case 13. Photograph of obturator appliance.
Fig. 46*B*.—Case 13. Photomicrograph. Mixed tumor growing in dense connective tissue. (Very low power.)

X-ray examination revealed a soft tissue tumefaction inferior to the posterior aspect of the hard palate. There was no definite evidence of bone destruction.

On September 13, the tumor of the hard palate was excised. Under endotracheal ether anesthesia, an elliptical incision was made around the tumor and carried down through the mucosa and periosteum to the palate. The tumor was then freed from the palate with a periosteal elevator. A portion of the tumor penetrated the palate and this was severed by sharp dissection. Sutures were then placed across the wound and a pack of iodoform gauze was placed in the defect.

Gross Description.—A smooth, somewhat oval-shaped tumor measuring 3.5 by 2.5 by 1 cm. was submitted. Sections were taken through it to determine whether or not the excision had been adequate. On section, it was grayish-white in color and there was questionably a small thin capsule present around it.

Microscopic Description.—Beneath the stratified squamous epithelium, a few normal-appearing mucous glands were seen. The tumor showed various structures. Cells were arranged in the form of glands. Young and mature connective tissue and questionably young cartilage were seen. There were very few mitotic figures. A few of the vessels showed marked subintimal thickening and one artery was completely obliterated. The capsule was made up of hyalinized connective tissue.

Microscopic Diagnosis.—Oral cavity, hard palate: Benign mixed tumor. (Fig. 46*B*.)

As the tumor had invaded the nasal cavity, complete removal was not possible. Because of this incomplete removal, radium was implanted in the defect and the patient received a total of 800 mg. hours of radium irradiation. She was re-examined in November, 1941, and complained that fluids taken by mouth ran into her nose. The fistulous opening could not be seen, but obviously there was one present. In January, 1942, the patient still complained of the fluids running into her nose. At this examination, a clearly visible fistula 1 cm. in diameter was seen to open into the nasal cavity, but there was no trace of persistent tumor. (Fig. 45.) The only complaint at subsequent examinations was the difficulty with fluids, but no tumor was ever noted. The patient was admitted in January, 1943, for construction of an upper obturator appliance. (Fig. 46*A*.) The last examination took place in October, 1943, at which time there was no evidence of any recurrent tumor and the obturator was functioning adequately. The patient talked and ate with no difficulty.

Comment.—The slow growth of this tumor and its appearance and location made the diagnosis of benign mixed tumor very probable. The characteristic tendency of these tumors to invade contiguous underlying structures was well borne out in this case. Complete surgical removal of the tumor was impossible, and for this reason postoperative radium insertion was done. This patient has been followed for somewhat over two years without having evidence of recurrence, but the time interval is too short to be of any value. The chances of local recurrence are high because of inadequate removal, but this recurrence may not appear for many years.

Case 14, S. L., EFSCH No. 6026

This 73-year-old male was first admitted to the hospital on Jan. 9, 1944. Two months previous to admission, his upper denture began to cause some soreness of the mucosa. He went to a dentist who removed the crown on a molar tooth, which resulted in a fixed partial denture becoming very loose. Two weeks later he noted a raised sore on the hard palate just to the left of the midline. On Dec. 23, 1943, an osteopath prescribed local application of a black liquid. Two weeks later, a physician referred him to our hospital.

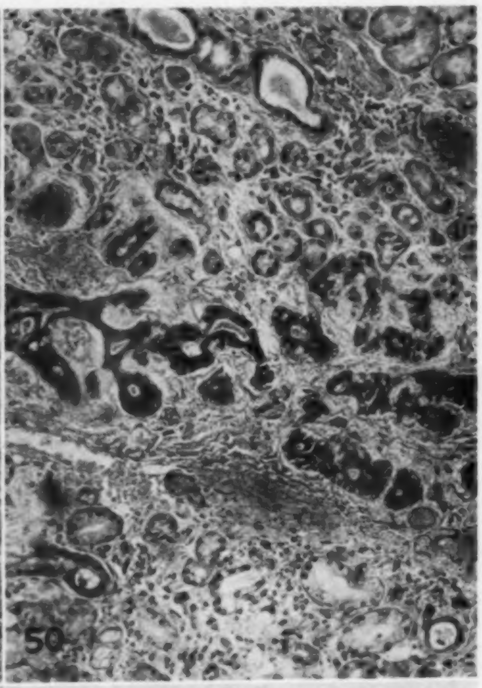


Fig. 47.—Case 14. Photograph showing mixed tumor of soft palate.
Fig. 48.—Case 14. Photograph of operative specimen.
Fig. 49.—Case 14. Photograph of operative specimen.
Fig. 50.—Case 14. Photomicrograph. Mixed tumor at possible area of origin. (Low power.)

Examination revealed a firm, circumscribed mass just to the left of the midline on the posterior aspect of the hard palate (Fig. 47). It measured 1.5 by 1.3 by 0.5 cm., was sharply delineated, superficially and centrally ulcerated, and slightly fluctuant on pressure. The few remaining teeth showed advanced carious destruction and there was no superficial cervical lymphadenopathy.

X-ray examination showed no evidence of bone destruction, and biopsy revealed a typical mixed tumor. On Feb. 1, 1944, the patient was taken to the operating room and a wide circular incision was made around the mass, leaving about a 1 cm. border. This incision was carried down to the bone of the hard palate and a chisel was used to remove a circumference of bone only slightly smaller than the area of mucosa removed. A bridge of soft palate was left posterior to this resection. Considerable bleeding occurred, and it was thought that the right palatine artery had been divided. A gauze pack saturated with zinc oxide controlled the bleeding.

The specimen (Figs. 48 and 49) consisted of the tumor of the hard palate, surrounding soft tissue and portion of bone. There was a 1.5 cm. area of superficial ulceration. On section of the tumor it was homogeneous, grayish-white in color, and everted. There was apparently an adequate area of normal tissue surrounding the tumor. Microscopically, this tumor showed acini accompanied by mucoid material and a variable amount of connective tissue stroma. This tumor was sectioned at various levels, and in one area was apparently arising from mucous glands which were very prominent. The excision was adequate. (Fig. 50.)

The postoperative course was uneventful. The follow-up has been too short to be of any value.

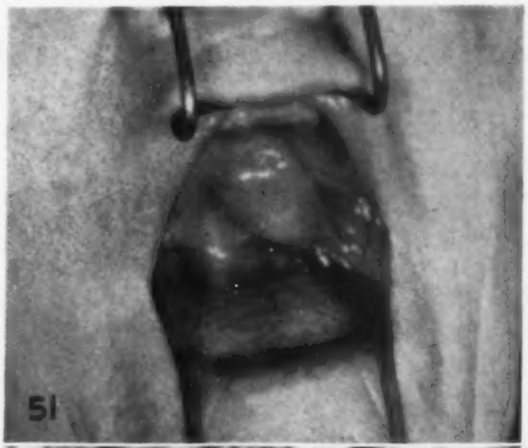
Comment.—This patient had a typical benign mixed tumor of the hard palate, but, as shown by pathologic examination, the excision would not have been adequate if bone had not also been removed with it. In the hard palate this is technically possible. If this tumor had been simply shelled out, the chances of recurrence during the next few years would have been fairly high. However, in a patient of this age, 73 years, recurrence might not appear during his normal life span. This radical procedure is to be recommended whenever technically possible, and it is particularly to be recommended in younger individuals.

Case 15, B. W., EFSCH No. 6010

This 67-year-old white woman was first seen in the clinic on Jan. 17, 1944. The chief complaint was a lump in the palate which had been present for ten years and interfered with the wearing of her upper denture. There was no complaint of pain.

Examination showed a firm, nodular mass in the thickness of the left side of the soft palate, firmly connected with the palatine bone. It was not ulcerated. It first appeared to be behind the soft palate, but on examination of the nasopharynx, no mass was seen around the eustachian tube and the tumor appeared to be in the substance of the soft palate. (Fig. 51.) Several aspiration biopsies failed to give any positive findings.

On January 31, under endotracheal ether anesthesia, the tumor of the soft palate was excised. A longitudinal incision 2.5 to 3.5 cm. in length was made over the tumor on the left side of the soft palate, after which the capsule of the tumor was identified and the tumor shelled out. The incision was closed with several interrupted catgut sutures.



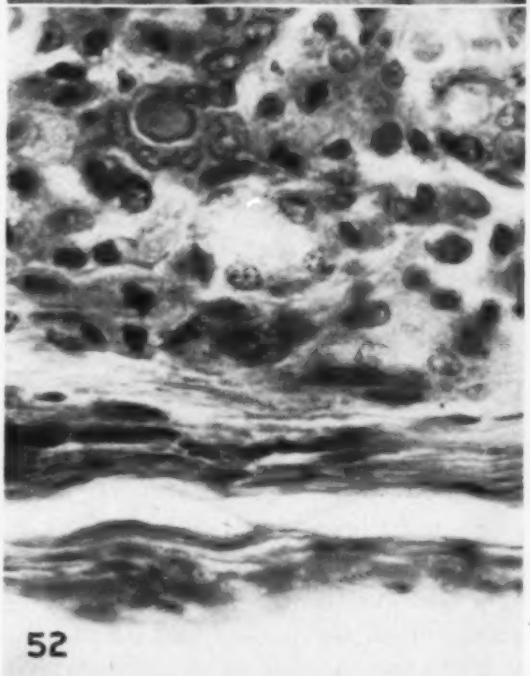


Fig. 51.—Case 15. Intraoral view showing mixed tumor of soft palate.
Fig. 52.—Case 15. Photomicrograph. Mixed tumor invading capsule. (High power.)

Gross Description.—The specimen consisted of a kidney-shaped, encapsulated tumor measuring 2.4 by 1.5 by 1.3 cm. It was light yellow in color and firm to palpation. At one of the poles, there was a slight rent in the capsule and from this was protruding a yellowish, granular, somewhat friable type of tissue.

Microscopic Description.—The entire tumor was sectioned at various levels. It was a typical mixed tumor with areas of mucoid degeneration and had a fairly orderly architecture. In many areas the tumor invaded the capsule out to its extreme limits, making it doubtful as to whether it had been completely excised.

Microscopic Diagnosis.—Oral cavity, soft palate (salivary mucous glands): Benign mixed tumor. (Fig. 52.)

Except for some nausea and vomiting for the first thirty-six hours, the postoperative course was uneventful, and the patient was discharged on February 5.

Comment.—The ease with which the tumor shelled out is typical of a benign mixed tumor. The invasion of the capsule is also fairly common, and this is one of the reasons these tumors have a high incidence of local recurrence. This tumor was located in the soft palate, a slightly less common site for mixed tumors than the hard palate. Whenever possible, these tumors should not be shelled out, but the excision should be carried around the tumor. A wider excision would have been preferable in this case, but technical difficulties, the location of the lesion, and the age of the patient made this inadvisable. Postoperative radiation, in our opinion, was not indicated.

This patient is 67 years old and the chances are good that recurrence will not take place within her normal life span.

This case and Case 13, which were both mixed tumors of salivary glands occurring in the palate, re-emphasize the importance of careful periodic examination in the edentulous mouth. These lesions may be erroneously diagnosed as the common tori palatini or other exostoses, or as simple benign hypertrophy resulting from denture trauma. The so-called denture sore is not a lesion to be considered lightly, but deserves careful study for differential diagnosis.

VIII. BENIGN LESION OF THE GINGIVA SIMULATING A NEOPLASM

Case 16, D. B., EFSCH No. 5831

Introduction.—Lesions of the gingiva associated with infection may produce tumefactions which might be confused with true neoplasms. The following case illustrates this point.

This 67-year-old white woman was first seen in the clinic in November, 1943. About two years before, the patient had noticed a small nodule on the labial surface of the right lower gingiva which she called a gumboil. This gradually increased in size for the next six months, and when she finally consulted her dentist she was told that the extraction of two or three teeth would remove this growth. She did nothing about this, however, until three weeks before her admission here, when she consulted her local physician and was referred to this hospital. There had been no pain, the mass had never bled, and the only complaints were its size and interference with speech.

Examination of the mouth showed the teeth to be dirty and encrusted with calculus. On the labial aspect of the lower right gingiva was a firm nontender

mass 3.5 by 2.5 by 2 cm. with no ulceration and normal-appearing mucosa. The patient was admitted for studies. (Fig. 53.)

X-ray examination of the right mandible revealed a large soft tissue tumefaction containing several small irregular flecks of calcific density extending upward from the alveolar ridge between the premolars. The crowns of the adjacent teeth were directed away from the tumefaction. There was a moderate amount of periapical radiolucency suggesting inflammatory change about the roots of the teeth, especially in the region of the mandibular symphysis. In this area, particularly in the anterior portion of the left mandibular body, the architecture of the bone was coarse and in part deficient.

Fig. 53.—Case 16. Oblique view of mandible showing calcific density and displacement of teeth produced by benign nonneoplastic lesion.

Fig. 54.—Case 16. Photograph of operative specimen.

Fig. 55.—Case 16. Radiograph of operative specimen.

Fig. 56.—Case 16. Photomicrograph. Abundant connective tissue and small spicules of bone. (Very low power.)

On Nov. 22, 1943, the tumor of the right mandible was excised. A bilateral mandibular block was done with procaine anesthesia and a bovie knife incision was made from the mesial aspect of the lower second molar on the buccal surface around to the distal surface of the left lower first premolar area. The buccal mucosa was reflected below the apices of the teeth, and the alveolar process was removed with the teeth and the tumor. The mucous membrane of the lingual alveolar process on the floor of the mouth was freed and all bleeders clamped and ligated with 000 catgut sutures. The remaining upper teeth were extracted and the mucosa in the mandible was closed with black silk sutures.

Gross Description.—The specimen consisted of four very dirty teeth with heavy calcific deposits attached to a segment of alveolar ridge. Between the first and second tooth, there was a tumor mass which measured 3 by 2 by 2 cm. It was very firm, grayish-white in color, and on section cut with increased resistance. (Figs. 54 and 55.)

Microscopic examination revealed marked fibrosis with rich infiltration of plasma and round cells. Connective tissue stroma was very dense. Still deeper, bone was present.

Microscopic Diagnosis.—Chronic inflammation, etiology undetermined. (Fig. 56.)

The postoperative course was uneventful, and the patient was discharged from the hospital on November 30. She was last seen in March, 1944, at which time there was no evidence of recurrent tumor and the prognosis seemed very good.

Comment.—As can be noted from the photograph of the gross specimen, the condition of the teeth and gingiva is extremely bad. The exuberant tissue growing between and distorting the teeth was made up of dense connective tissue accompanied by signs of inflammation. This is not a true tumor, but the end results of an inflammatory process for which the treatment given was adequate and reasonable. Recurrence probably will not occur and the patient is probably cured. Ordinarily, in speaking of preventive measures in dentistry, discussion is limited to control methods for dental caries, gingivitis, and periodontitis. Prevention of lesions of the type in this patient can be credited to restoring teeth, eliminating hopelessly decayed teeth, and better oral hygiene including office and home care. In this way the dentist must fully realize his role in the move toward preventive therapy.

IX. CYSTIC LESIONS OF THE JAW

Introduction to Cases 17 and 18.—Cystic lesions of the jaws, while not true neoplasms in most instances, often present diagnostic problems. For the purpose of diagnosis the cyst and cystlike lesions may be divided as follows:*

- A. Developmental cysts
  - I. Dental origin
    - a. Periodontal (radicular, periodontal and residual varieties)
    - b. Dentigerous
    - c. Primordial (so-called follicular)
  - II. Nondental origin
    - a. Median (maxillary, mandibular, palatine varieties)
    - b. Nasopalatine (incisive canal)
    - c. Globulomaxillary
  - III. Neoplastic
    - a. Ameloblastoma (adamantinoma, adamantoblastoma)
- B. Cystlike lesions
  - I. Extravasation (hemorrhagic, traumatic) cyst
  - II. Cystlike neoplasms
  - III. Metabolic disturbances simulating cysts

*A detailed discussion of this classification will be published by one of us (H. R.)

The following two cases are representative of two of these cysts (periodontal or primordial, and dentigerous). Case 11 represented a third (ameloblastoma). Many of the other cases presented herewith illustrate cystlike neoplasms which clinically and radiographically may simulate true cysts.

Case 17, L. F., EFSCH No. 2031

This 54-year-old white woman was first seen in the clinic in September, 1941. The chief complaint was a slowly growing swelling in the left cheek which the patient said had been present for thirty-three years. She gave a history of having bumped her cheek against a washing machine wringer and this firm swelling had been present ever since, increasing quite rapidly in size in the past six months. There had never been any pain.

Examination revealed a hard, globular swelling in the left upper buccogingival fold, which extended into the substance of the left cheek and was apparently continuous with the antral wall. The teeth, which were carious and involved by periodontitis, were extracted upon her admission to the hospital purely as a prophylactic measure.

X-ray examination showed the left antrum to be cloudy. In the anterior lateral aspect of the left maxilla was a sharply defined, circular shadow of increased soft tissue density. There was expansion of the anterior lateral wall of the left antrum. The alveolar portion of the maxilla, posterior to the premolar, was included in a soft tissue tumefaction. (Figs. 57 and 58.)

The patient was prepared for surgery on Oct. 15, 1941. Endotracheal ether was administered, a mouth gag was inserted, and a cheek retractor was used to expose the lesion. An incision was made parallel to, and about 1 cm. from, the gingival margin, and was carried down through the mucosa to the fibrous wall of the cyst where a good cleavage plane was found. By blunt dissection, the cyst was quite easily freed from the surrounding tissues. At one point in the outer superior portion, the wall of the cyst was quite thin and was inadvertently broken toward the end of the procedure. All debris was carefully washed away with hot saline. Hemostasis was secured with hot saline packs and black silk ties along the edges of the mucosa. The flaps of the remaining mucosa were found to be inadequate for lining the defect and were simply packed in place, as high as possible, with one iodoform gauze pack.

Gross Description.—The specimen consisted of a cyst measuring 3 by 2.5 by 2.5 cm. The wall appeared to be made up of gray fibrous tissue. In the wall were numerous thin plates of what appeared to be bone. The lining of the cyst was rough, dark yellowish-brown, and the cyst cavity was filled with greasy, dark yellowish-brown, amorphous material. (Fig. 59.)

Microscopic Description.—A cyst wall composed of dense connective tissue which was lined by a thin layer of degenerated, flattened epithelium was seen. On the opposite aspect of the wall was a thin layer of bone. The wall was moderately infiltrated with chronic inflammatory cells and cholesterol clefts were prominent (Fig. 60.)

Microscopic Diagnosis.—Benign cyst of the maxilla.

The postoperative course was uneventful and the pack was removed the third postoperative day. The patient was discharged with instructions for saline irrigations at home three times a day.

The patient was last seen in July, 1943, at which time there was no evidence of recurrent or persistent tumor.

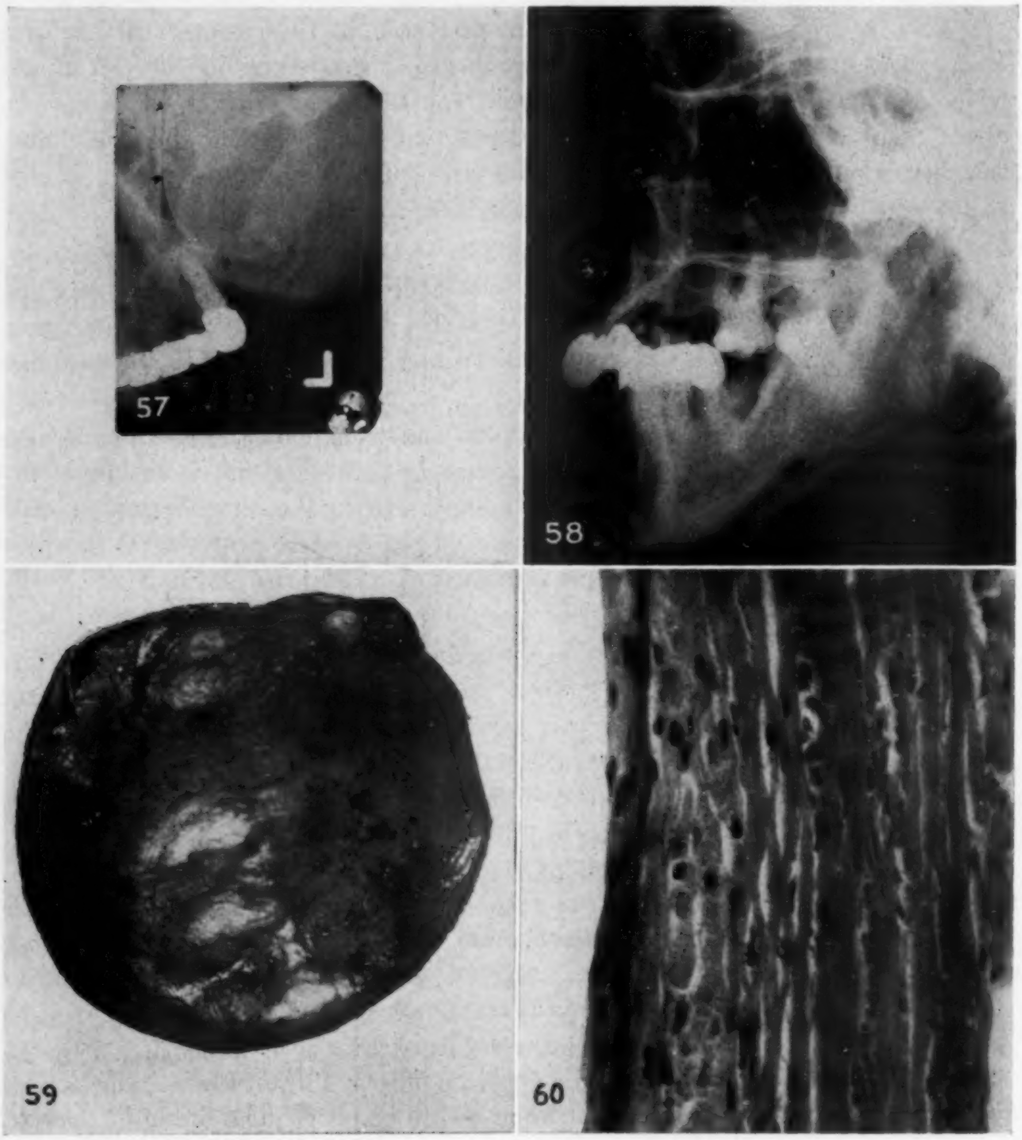


Fig. 57.—Case 17. Occlusal view of left maxilla showing sharply defined spherical mass suggestive of benign cyst (outlined by arrows).
Fig. 58.—Case 17. Lateral radiograph.
Fig. 59.—Case 17. Photograph of operative specimen.
Fig. 60.—Case 17. Photomicrograph of cyst wall with squamous epithelial lining.

Comment.—Since this cyst, at the time of operation, contained no tooth root or tooth crown material, it was not diagnosed as a radicular type of periodontal cyst or as a dentigerous cyst. The position rules out median and globulomaxillary cysts. The histologic picture suggests only a benign cyst. The ques-

tion of differential diagnosis lies between primordial (enamel organ degeneration) cyst and residual type of periodontal cyst. The fact that a large radiolucency exists about the remaining left canine, and not the other teeth, suggests dental neglect. We might therefore assume that this represents a residual periodontal cyst. The long history of a swelling following trauma is not incompatible with this, as these cysts may be of extremely slow growth. Events of thirty-three years past may be falsely evaluated by the patient and infection or other factors may stimulate growth in a dormant cyst. The final differential diagnosis between a primordial cyst of an enamel organ and a residual periodontal cyst, is chiefly of academic importance, but serves to exemplify the diagnostic problems that may arise.

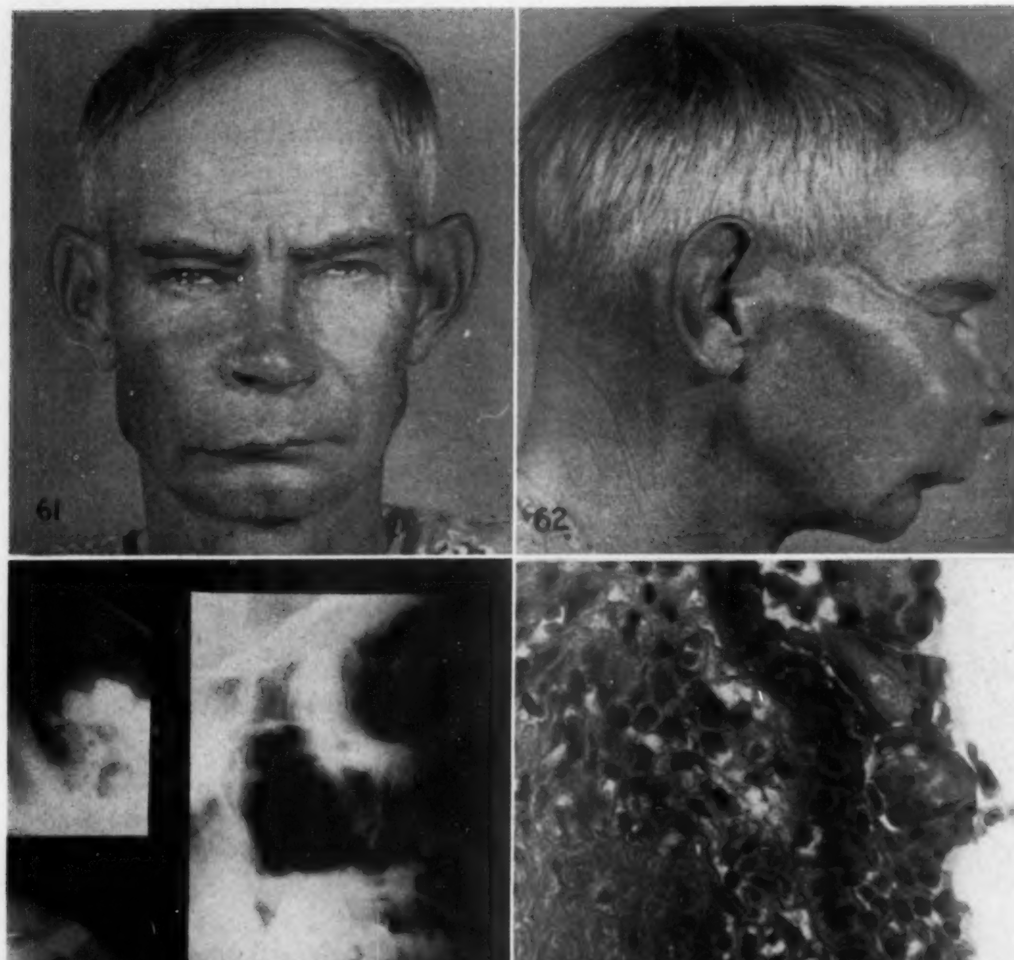
Case 18, C. M., EFSCH No. 2238

This 50-year-old white man was first seen in the clinic in November, 1940. There was a mass over the right antral region which had been developing gradually since 1934, after the extraction of a tooth. The patient stated that at the time of extraction a piece of bone had come out with the tooth. The dentist sent this tissue to a laboratory for pathologic examination, but the report was negative. The mass had drained prune-colored fluid intermittently, the swelling subsiding each time, only to recur shortly thereafter.

Examination revealed a definite deformity of the right side of the face over the antral region which was seen intraorally as a smooth, hard, slightly tender mass with intact, normal-appearing mucosa over it. There was no fistula or ulceration. The remaining teeth were dirty and carious. There was no palpable lymphadenopathy. The patient was admitted for study. (Figs. 61, 62, and 63.)

X-ray examination revealed a soft-tissue tumefaction extending anteriorly from the right malar region. Within the tumor mass was an area of relatively heterogeneous translucency surrounded by a thin, slightly fragmented, dense capsule, with no apparent trabeculations. The capsule extended superiorly to the right infraorbital rim mesially beyond the medial border of the antrum and inferiorly below the floor. Hypertrophic changes of the maxilla were seen at the tip of the nasal spine. In the premolar area was a dense body suggestive of an unerupted tooth. A defect was present in the maxilla between the unerupted tooth and the left lateral incisor. The posterior and lateral walls of the right antrum were intact. (Fig. 63.)

On Jan. 14, 1941, under endotracheal ether oxygen anesthesia, an excision of the cyst was performed. The incision was made along the gingival ridge from the midline to the region of the molars. The mucosa was reflected back both laterally and medially. The cystic cavity was then entered and the opening enlarged sufficiently for exploration. With rongeurs and bone forceps, the major portion of the lateral and inferior wall was removed. The tooth was extracted from its socket in the palatal bone and the fibrous lining of the cyst was removed with blunt dissection and curettement. The edges of the bony defect were smoothed down as far as possible with rongeurs and the mucosal flaps were partially sutured together and invaginated into the cavity. An iodoform gauze pack, which had been rinsed in saline, was inserted to hold the flap firmly



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against the bony wall and this pack was held in place with three silk sutures extending from the middle of the palate to the mucobuccal fold.

Gross Description.—The specimen consisted of several eggshell bits of bone, evidently from the cyst wall, and some small, soft reddish-pink bits of soft tissue. A tooth was also present.

Microscopic Description.—Decalcified sections showed a large amount of blood, connective tissue, and small vessels. In the wall of the cyst there were small nests of cells with even, blue-staining nuclei and pale cytoplasm. They presented a pseudoglandular arrangement. Because of old hemorrhage, a small amount of hemosiderin pigment was present. There was no evidence of malignancy.

Microscopic Diagnosis.—Dentigerous cyst. (Fig. 64.)

The postoperative course was uneventful, and the patient was discharged on Jan. 21, 1941, with instructions for soft diet and frequent mouth irrigations at home. Re-examination in March showed no noticeable external deformity. There was, however, a nasooral fistula in the superior right angle of the defect at the operative site. This was closed under local infiltration anesthesia. The patient was last seen in July, 1943, at which time there was no evidence of disease. (Figs. 65 and 66).

Comment.—The history and radiographs, the finding of a tooth crown within the cyst, and the microscopic picture make the diagnosis of dentigerous cyst the only one possible, if one accepts as the definition of a dentigerous cyst, an epithelial-lined sac containing a tooth crown or an anomalous tooth (odontoma) and probably arising by degenerative changes in the reduced enamel epithelium. The rather radical operation performed with the removal of the entire lining membrane of the cyst was done to prevent recurrence, which sometimes occurs if the lining epithelium of the cyst remains behind.

X. MULTIPLE HEMANGIOMAS OF THE ORAL CAVITY

Case 19, D. K., EFSCH No. 5113

Introduction.—Cavernous hemangiomas of the oral cavity are relatively common. They are unlikely to be confused with any other lesion. They are soft, grayish-blue in color, and they blanch on pressure. They often are multiple in the oral cavity. Cavernous hemangiomas are either congenital, or form in later life.

This 32-year-old white woman first came to the clinic on March 29, 1943, with a complaint of blood vessel tumors in the lower lip, tongue, and cheek. During the past two years, the growth on the lower lip had doubled in size and the one on the tongue had increased about one and a half times. She had had

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Figs. 61 and 62.—Case 18. Preoperative photographs of patient showing deformity in right infraorbital region produced by dentigerous cyst.

Fig. 63.—Case 18. Lateral jaw plate and two occlusal films showing radiolucent area containing a toothlike radiopaque mass (indicated by arrows) and suggesting a dentigerous cyst.

Fig. 64.—Case 18. Photomicrograph of area of cyst wall showing connective tissue capsule and epithelial lining.

Figs. 65 and 66.—Case 18. Postoperative photographs of the patient.

no treatment. There were no symptoms of bleeding from the gastrointestinal or genitourinary tracts nor had the hemangiomas of the oral cavity ever bled.

Examination of the left lower lip revealed a soft, bluish, circumscribed nodule measuring 2 by 2 by 1 cm. On the left and mid-lateral surface of the tongue there was a poorly circumscribed soft tumor measuring 4 by 3 by 2 cm., and in the right buccogingival gutter of the maxilla was a third measuring 2 by 2 by 1 cm. The veins of the floor of the mouth were prominent. This patient was admitted for therapy. (Fig. 67.)

On April 1, sodium morrhuate injections to the multiple hemangiomas were given as follows: 1 c.c. into the lip lesion, 2 c.c. into the hemangioma on the tongue, 0.5 c.c. in the buccal mucosa lesion. On May 21, examination revealed the hemangioma on the lower lip to have regressed to less than 0.5 cm. in diameter. There were several small areas averaging about 0.5 cm. in diameter still present on the lateral border of the tongue. The lesion of the right buccal mucosa had completely disappeared. Further minor treatments were necessary, but it was felt best to wait until the scarring was more complete.

Fig. 67.—Case 19. Photograph showing cavernous hemangioma of the tongue and lower lip.

By October 8, the hemangioma on the left border of the tongue had completely regressed and the lesion on the right upper buccal mucosa remained healed. The hemangioma of the left lower lip had increased slightly in size and the patient presented four new small hemangiomas on the labial border of the right lower lip, the left buccal mucosa, the right anterior border of the tongue, and the right tonsillar pillar. Sodium morrhuate injections were given in the clinic in the following quantities: 0.1 c.c. to the right labial lower lip, 0.2 c.c. to the left buccal mucosa, 0.3 c.c. to the right anterior border of the tongue, 0.2 c.c. to the right tonsillar pillar. The patient was admitted to the hospital and strict oral hygiene measures were instituted. There was very little edema, and she was discharged on October 12.

Our technique of sodium morrhuate injection is to use a 5 per cent solution of sodium morrhuate, a No. 25 needle, and a 2 c.c. or 5 c.c. syringe. The needle is inserted directly into the hemangioma at its base. The fluid is slowly injected until the lesion first shows evidence of blanching. The larger lesions demand the injection to be in a more infiltrating manner. Two or more points of insertion of the needle may be necessary. It is wise to determine the location of the feeding vessels of the hemangioma and inject in such a manner as to sclerose them. The danger involved in injecting too much sclerosing solution is a sloughing of the lesion with subsequent scarring of the surrounding tissues.

Re-examination of this patient on December 10, showed evidence of healing hemangiomas on the left border of the tongue, left buccal mucosa, and the left lower lip. All other areas were negative and no new hemangiomas were noted.

Comment.—In the oral cavity in an adult, cavernous hemangiomas are best treated by the sodium morrhuate injection technique outlined. It is much simpler than surgery, causes no deformity, and the results are superior. Because hemangiomas are relatively radioresistant, radiation therapy is not indicated.

XI. LEIOMYOMA OF THE TONGUE

Case 20, R. M., EFSCH No. 4293

The following case is an example of a rare tumor of the oral cavity:

This 32-year-old Negro man was first seen in the clinic in July, 1942. There had been no symptoms until May, 1942, when the patient noticed a small swelling on the right side of the floor of the mouth, apparently arising from the tongue. He consulted his local physician, who did a Wassermann and told him he had syphilis. He then received a course of antisyphilitic therapy for a period of three months up until three weeks previous to our examination. In the meantime, the mass had increased in size and become somewhat tender. There had been difficulty in swallowing for the past two months, but there had been no weight loss.

Examination revealed the remaining teeth to be carious and involved by periodontitis. Growing out of the right side of the floor of the mouth, pushing the tongue up, there was a large, grayish-white, moderately firm, nontender, irregular mass, measuring 7 by 4 by 4 cm. (Fig. 68.) No palpable submental or cervical lymphadenopathy was noted. The patient was admitted for study.

X-ray examination revealed some evidence of destructive bone changes involving the posterior alveolar margin of the left maxilla. The remaining teeth showed periapical radiolucencies, and a soft tissue mass was noted in the oral cavity.

A microscopic slide from the tongue was sent to us by the patient's physician.

Microscopic Description.—The overlying epithelium was absent. There was marked ulceration accompanied by dilatation of the blood vessels. The tumor was very cellular and had spindle-shaped nuclei. Most of the tumor seemed to be made up of connective tissue, but there were some cells which suggested smooth muscle origin. Mitotic figures were very rare. Phosphotungstic acid-hematoxylin stains showed that this tumor probably arose from

smooth muscle. The general picture was very suggestive of a vascular type of leiomyoma. The nucleoli and other morphologic features of the tumor cells were more suggestive of smooth muscle origin than of fibroblastic origin.

Microscopic Diagnosis.—Oral cavity, tongue: Leiomyoma.

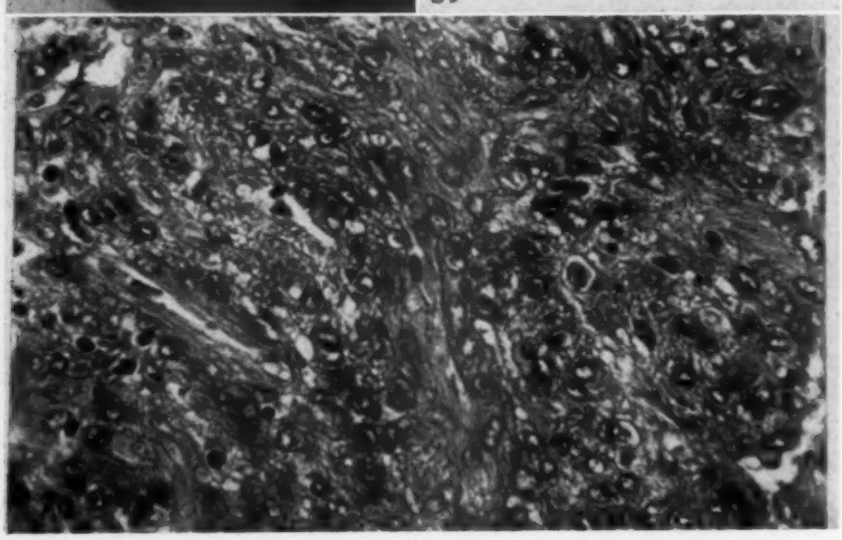

Fig. 68.—Case 20. Photograph showing leiomyoma in floor of mouth with displacement of tongue.

Fig. 69.—Case 20. Photograph of specimen.

Fig. 70.—Case 20. Photomicrograph. Vascular leiomyoma. (High power.)

On July 13, the mass in the mouth was surgically excised under endotracheal ether anesthesia. The incision was made anteriorly at the floor of the mouth around the mass, giving a 1.5 cm. margin on all sides. This incision was deepened to cut through the muscular base of the tongue along the posterior margin of the mandible, out laterally to the pterygoid, and posteriorly to within 0.5 cm. of the pharynx. It was then carried down to the base of the mass. The lingual artery and vein were ligated and the lingual nerve was, of necessity, removed with the mass. The lateral and medial flaps were brought together and closed with interrupted silk. The patient was returned to the ward in good condition with an airway in place.

Gross Description.—The specimen consisted of a tumor measuring 5.5 by 6 by 1 cm. Its surface was ulcerated over a small area and it included muscle from the floor of the mouth. It extended up along the gingiva on the mandibular ridge. On section, it cut with increased resistance and was homogeneous grayish-white in color. (Fig. 69.)

Microscopic Description.—The surface showed ulceration, beneath which were sheaths of tumor cells. Tumor was abundantly supplied by small blood vessels. Individual cells had somewhat spindle-shaped nuclei, and the arrangement of the tumor suggested a leiomyoma. In several areas, it was very cellular and mitotic figures were frequent. A careful search was made for definite myofibrils with the phosphotungstic acid-hematoxylin stain, but definite fibrils were not identified. However, as it strongly resembled leiomyomas previously described by Stout,[21] and because he accepted it as probably a vascular leiomyoma, it was put in that category. (Fig. 70.)

Microscopic Diagnosis.—Oral cavity, tongue: Leiomyoma.

The postoperative course was uneventful, and the patient was discharged on July 23. He was re-examined at three-month intervals with no evidence of local recurrence until March 3, 1944. At that time, examination revealed a hard, indurated mass, measuring 2 cm. in diameter, present in the region of the tonsillar pillar, adjacent to the base of the tongue. This mass was fixed to the mesial portion of the mandibular angle. A keloid had developed on the neck and although this mass might also represent overproduction of connective tissue, it strongly suggested recurrence of the tumor. The patient is to be followed at shorter time intervals, and if recurrence is definite, further surgery is anticipated.

Comment.—This tumor was thought to be completely excised, although in one area excision was possibly inadequate. In spite of the fact that microscopically it was classified as a benign tumor and unlikely to metastasize, local recurrence would be expected if it had been incompletely removed. These tumors can arise from the smooth muscle of blood vessels, which would be the natural supposition in this instance. If the mass seen at the last examination increases in size, the posterior portion of the right mandible should be resected en bloc with the adjacent posterior portion of the tongue and tonsillar pillar. X-ray therapy would be of no value.

The authors are deeply indebted to the following men from The Ellis Fischel State Cancer Hospital for their contributions to this paper: Everett D. Sugarbaker, M.D., Chief Surgeon; David V. LeMone, M.D., Diagnostic Roentgenologist; Juan A. del Regato, M.D., Radiotherapist; J. F. Barham, Photographer.

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Fracture Review

A HISTORICAL REVIEW OF METHODS ADVOCATED FOR THE TREATMENT OF JAW FRACTURES, WITH TEN COMMANDMENTS FOR MODERN FRACTURE TREATMENT

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THIS review deals with fractures of the facial bones that have occurred both in peace and war, from the earliest times of which records are available, to the present day. It is noteworthy that, in olden as well as in our more enlightened modern times, the greatest progress in the development of treatment methods was made during periods of war. Hippocrates was cognizant of this fact, and advised those who desired experience in the treatment of injuries to follow the armies into battle.

The invention of firearms as weapons of war in the middle of the thirteenth century brought with it new types of wounds and fractures, and modern warfare produces these in large variety on an unprecedented scale.

Even in peacetime during the last decades, fractures of the jaws have increased in number. This is due to the participation by the general public in a variety of sports, as well as to the widespread use of the automobile and airplane for transportation.

World War I was the cause of so many fractures that their treatment became an important branch of military surgery. The increased civilian accidents occurring to patients who were particular regarding the outcome and cosmetic results made it necessary to develop reduction and fixation methods that gave better results than had ever been obtained before. At the present time, the experience of the past is being combined with experimentation along new lines. New methods and new materials are being applied, and these promise to be of great aid to the surgeon in World War II.

THE TREATMENT OF FRACTURES IN ANCIENT TIMES

The oldest information on fractured jaws may be found in the *Edwin Smith Surgical Papyrus*, acquired by Smith at Luxor in 1862, and translated by James H. Breasted (1930). This papyrus is believed to have come down to us from the seventeenth century B.C., and is thought to be a copy from an original which was produced at least one thousand years earlier. It was written, therefore, sometime in the Pyramid Age (3000-2500 B.C.). It is probably

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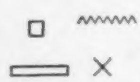
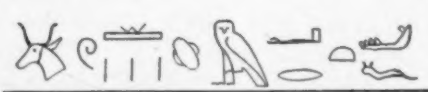
identical with the *Secret Book of the Physician* mentioned in the papyrus Ebers. Breasted wrote in his preface that this document disclosed to us for the first time the human mind peering into the mysteries of the human body, recognizing conditions and causes as due to intelligible physical factors.

Forty-eight cases of surgical conditions are described. Among twenty-seven head injuries there are several sword cuts and arrow wounds sustained by soldiers of the Eleventh Dynasty (2100 B.C.). One (Case 24) is a case of fracture of the mandible, and three are injuries of the cheek, by which the Egyptians meant the maxilla, zygoma, and even the temporal bone. Injuries are classified as perforation  pronounced "thm" (mostly caused by spear thrust); split  pronounced "pšn" (made by battle-axe); and smash  pronounced "śd" (meaning comminuted fracture).

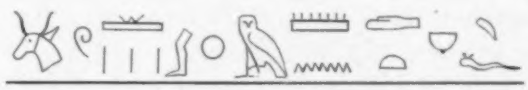


(Instructions Concerning a Fracture in His Mandible)

The following is Breasted's translation of the hieroglyphics dealing with the examination, diagnosis, and treatment of this fracture: "If thou examinest a man having a fracture in his mandible, thou shouldst place thy hand upon it. Shouldst thou find that fracture crepitating under thy fingers, thou shouldst say concerning him: 'One having a fracture in his mandible, over which a wound has been inflicted (several words are unintelligible here), (and) he has fever from it: An ailment not to be treated.' "

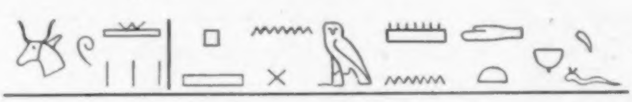
Breasted's comment about the verdict in the case of the mandible is to the effect that the injury described was serious enough to cause fever, for which reason the unfavorable verdict was given that meant there was no hope for the patient's recovery. In the old Empire, however, dental infection seems to have been recognized and treated. This is evidenced by a mandible that I discovered (Thoma, 1917) among a number of mummies of the Fourth Dynasty (2900-2750 B.C.), and which I studied with the permission of Professor Earnest A. Hooton at the Peabody Museum of Harvard University. Two holes had been drilled through the cortex of the bone to drain an abscess under a molar tooth in which a perforation of the occlusal surface caused by severe masticatory attrition had opened the path for infection into the pulp canal. This conclusion was verified by Professor Hooton and described in his Harvard African Studies. Breasted suggested that specialized surgical instruments made of bronze already existed in those days, but that they were taken

for granted since no mention of them was made in the ancient papyrus, and no Egyptian bodies exhumed showed any traces of trepanning, although in the addenda of the book it was mentioned that Dr. Aleš Hrdlička had reported the discovery in the "deep pits at Lisht" of a trepanned skull belonging to one of the nobler families of the Twelfth Dynasty.



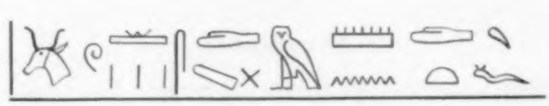
(Instruction Concerning a Perforation in His Cheek)

Regarding this case, Breasted's translation reads: "If thou examinest a man having a perforation in his cheek, shouldst thou find there is a swelling protruding and black, (and) diseased tissue upon his cheek, Thou shouldst say concerning him 'One having a perforation in his cheek. An ailment which I will treat.' Thou shouldst bind it with YMRW and treat it afterward (with) grease (and) honey every day until he recovers."



(Instruction Concerning a Split in His Cheek)

The instructions are: "If thou examinest a man having a split in his cheek, shouldst thou find that there is a swelling protruding and red, on the outside of that split, Thou shouldst say concerning him: 'One having a split in his cheek. An ailment which I will treat.' Thou shouldst bind it with fresh meat the first day. His treatment is sitting until its swelling is reduced. Thou shalt treat it afterward (with) grease, honey, (and) lint every day until he recovers."



(Instruction Concerning a Smash in His Cheek)

This case is interpreted as that of a "compound comminuted fracture of the bone in the region of the maxilla and zygoma."

This injury had an unfavorable verdict as is evidenced by the following statement: "One having a smash in his cheek, while he discharges blood from his nostril, from his ear, (and) from his mouth, (and) he is speechless. 'An ailment not to be treated.' "

In general, the Egyptians did not consider it possible to treat compound fractures, as is shown by the following statement: "A serious rupture of the soft tissue over a fracture creates a condition which he cannot hope to treat successfully."

ANCIENT GREECE

Other old documents dealing with fractures of the jaws are the works of Hippocrates (400 B.C.). In ancient Greece, accidents which occurred among the athletes and gladiators gave Hippocrates ample opportunity to become familiar with fractures of all types, as his writings testify. His advice regarding the reduction of fractures of the jaw was so comprehensive that it may be followed successfully today. He stated: "In fractures of the lower jaw, when the bone is not fairly broken across, and is still partially retained but displaced, it should be adjusted by introducing the fingers at the side of the tongue and making suitable counter-pressure on the outside; and if the teeth at the wound be distorted and loosened, when the bone is adjusted they should be connected together, not only two but more of them, with a gold thread if possible, but otherwise with a linen thread, until the bone is consolidated; and then the part is to be dressed with cerate, a few compresses, and a few bandages, which should not be very tight, but rather loose."

Hippocrates realized the importance of giving attention to the occlusion when treating a fracture of the jaw. "If reduction has been well performed, and the part kept in proper repose, the consolidation takes place in a short time and the teeth do not undergo any damage. In the contrary case the cure is retarded, the fragments reunite in a bad position, and the teeth become useless."

Hippocrates' thoughts on bandaging are just as apropos today as they were then, because the inexperienced frequently displaces, by bandaging, the fragments that have been properly reduced. He wrote: "It should be well known that in fractures of the jaw, dressing with bandages if properly performed is of little advantage, but occasions great mischief if improperly done. Those physicians who have not judgment combined with dexterity, expose themselves in fractures of the jaws as in other cases, for they apply a variety of bandages to a jawbone, sometimes properly and sometimes improperly. For all such bandaging of a fractured jawbone has a tendency rather to derange the bones connected with the fracture than to bring them into their natural positions."

THE ROMANS

The Romans also have left evidence that they recognized fractures of the mandible, although they did not improve much on Hippocrates' methods of treatment. Aulus Cornelius Celsus (30 B.C.) in his book *De Medicina* recommended the following method of fixation after the fragments of the jaw were set in place: "Tie together the two teeth nearest the fracture with a silk thread, or else if these are loose, the next ones. After this a thick compress should be applied dipped in wine and oil and sprinkled with flour and powdered olibanum. This compress is to be fixed in place by means of a strip of soft leather with a longitudinal slit in the middle to embrace the chin, the two ends being tied together above the head."

Thus Celsus applied horizontal wiring according to Hippocrates' method, but added a sling for the chin, the first use of which has been erroneously attributed to Galenus (A.D. 131), but was described even before the time of Celsus by Soranus of Efesus (A.D. 97) as "Capistrum simplex and duplex."

THE TREATMENT OF FRACTURES IN THE MIDDLE AGES

In the Middle Ages little that is new was added to the methods of Hippocrates. Avicenna of the Arabians (Eber-dina 980) wrote in his *Cantica* a chapter on mandibular fractures, but it contained nothing original. Albucasis (1050) of Cordova, the greatest surgeon of his age, had in his book a chapter entitled, "De restauratione Mandibulae inferioris, guando disrumptur." According to his illustrations, his methods were those of Hippocrates, namely, horizontal wiring. Anenzoar, on the other hand, according to his *Ae-Teisir* written in the beginning of the twelfth century, depended on bandages alone to retain the mandibular fragments in position. In the great textbook on surgery written in 1180 at Salernum, called *Glossae supra chirurgiam* by Maestro Ruggero from Parma, to which notes were added in the thirteenth and fourteenth centuries, the following treatment was given for fractures of the mandible: "Take olibanum, mastic, colophene, glue, dragon-blood; all this must be mixed with liquefied resin and becomes ointment which is placed over until complete consolidation, and everything must be fixed with the little lances, in order that the portions be prevented from moving out of place." Ruggero also stressed the importance of occlusion. He wrote: "The patient must be taken by the lower maxilla and this must be moved here and there until the lower teeth touch the upper ones."

The first time intermaxillary wiring was mentioned is in Guglielmo da Piacenza's *Praxeos Totius Medicinae* in 1275. He recommended a modification of the primordial method of ligating the teeth, advising the binding of the teeth proximal to the fracture, not only between themselves, but also to the corresponding teeth of the maxilla.

THE DAWN OF SCIENTIFIC DENTISTRY

With Pierre Fauchard, who wrote a book in 1728, *Traité de Chirurgie dentaire*, and who is considered the founder of scientific dentistry in France, a new development in the treatment of fractures began.

FRACTURES OF THE MAXILLA IN THE SEVENTEENTH AND EIGHTEENTH CENTURIES

Although Guérin in his memoirs and letters wrote as late as 1866: "Les fractures des maxillaires supérieurs sont si peu cannues qu'elles sont a peine mentionnées dans les ouvrages de chirurgie," a few reports have been discovered. Among military injuries mentioned by Wiseman (1676) who is known as "the Father of English Surgery," and was a noted military surgeon during the period of the Restoration, we find the following example of oral surgery as it was practiced at that time: "One was shot in the Face betwixt the Nose and Eye on the right side into the Ethmoids by a Pistol-bullet. After he had been cured from the external wound in his Face, he became troubled with a fretting Ichor, which discharged by the Nostril: especially at his first rising in the morning it would run half a spoonful of a yellowish color. After some years he felt the Bullet to rowl to and fro over the roof of his Mouth. We resolved Upon the cutting thro the Palat-bone, one holding his head steady, while I cut into the roof. I applied a bit of Caustick-stone and held it to the place, by which I consumed the soft

fleshy part over the bone, and afterward cut into the bone such a hole that in moving of his head I could see the bullet which was afterward taken out, and he eased of that discharge of matter which threaten'd a filthy carious ulcer." Other evidence that very little was known at that period about the treatment of maxillary fractures is illustrated by the crude method employed by Wiseman (1734) in the following case: The patient, a child who had been kicked by a horse, had the whole upper jaw forced in, so that it came into contact with the pharynx. It was reduced by Wiseman with the use of a hook placed in the mouth and behind the palate, which allowed him to pull the upper jaw forward. When removing the instrument, however, he found that the part was again pulled back. He constructed another instrument by which the maxilla could be held in place with the hands of the child, the mother, or others alternately, until union was effected. Wiseman stated that the result was better than could have been expected.

Fig. 1.—Chin bandage used in the eighteenth century for fractures of the lower jaw. (After Piperno.)

FRACTURES OF THE MANDIBLE IN THE EIGHTEENTH CENTURY

Chin slings were in use in this century. Such a sling is shown in the rare and interesting illustration seen in Fig. 1 taken from a book by Don Mauro Soldo (1766). It shows a double bandage of the head used for fractures of the mandible. It did not seem sufficient, however, to support the teeth correctly.

Robert Bunon, Bourdet, and Capperon perfected the technique of dental prosthesis, and so made it possible for dentists to use new methods for the treatment of fractures. Bunon (1743) described a case in which the previous attempt of an experienced surgeon had failed entirely. He treated the fracture by replacing a premolar, lost by the effect of the trauma, with a block of ivory provided with two holes. By means of ingenious crossing of thread around the teeth, he formed one solid block of the jaw. In spite of the fact that the teeth were

loose, he succeeded in bringing about consolidation of the "shaken" teeth, and cured the fracture in less than a month.

The scientific treatment of jaw fractures which started at the end of the eighteenth century must be accredited to France, particularly to Chopart and Desault, who included in their *Traité des Maladies Chirurgicale,* a chapter on fractures of the maxilla and the mandible. They stated that maxillary fractures, if simple, healed by themselves. If complicated by fragments which adhered to the soft tissue, these should be reduced, but if they were mobile and not much attached, they should be removed. The mandible, they stated, might be fractured at the chin, near the ramus, at the condyle, on one side, or both. They understood the effects of the elevator and depressor muscles on the fragments, and recognized complications caused by loose, fractured, and luxated teeth. They recommended reduction of these fractures, followed by methods of stabilization by means of threads or wires, binding the adjoining teeth together; or by means of bandages made up of iron hooks previously covered with linen, cork, or lead leaf and placed over the teeth or the alveolar border, attached with screws and nuts to a plate of sheet iron below the mandible.

FRACTURES CAUSED BY FIREARMS IN THE EIGHTEENTH CENTURY

Chopart and Desault wrote that in fractures caused by firearms the tract of the bullet should be enlarged by incisions, detached splinters of bone removed, and a wire inserted to prevent formation of abscesses, or caries and necrosis of the bone. They also said that if part of the jaw was lost, the parts should be brought together and artificial dentures or silver plates attached to the neighboring teeth, making the deformity less obvious.

THE STUDY OF THE ETIOLOGY OF JAW FRACTURES IN THE NINETEENTH CENTURY

The etiology of jaw fractures, their location, and the effect of muscle spasm on displacement of the fragments were for the first time thoroughly discussed in the nineteenth century. Boyer (1805), Lonsdale (1838), Buck (1847), Gibson (1841), Hamilton (1855), and Stephen Smith (1857) contributed knowledge on these points.

War Injuries in the Early Part of the Nineteenth Century.—Thomson (1816), surgeon to the British forces, reported on wounds of the jaws and face by cannon, gunshot, saber, and lance; these became increasingly frequent in the various campaigns carried on in this century. Reporting on the wounded at Waterloo, he stated, "Musket-balls seldom enter the mouth without fracturing the jaws, several cases of which were seen. In passing through the upper part of the mouth, the balls had not only fractured the jaw but they had also destroyed portions of the palate and removed the partition dividing the mouth from the nose. Fractures of the lower jaw, upon one side or both, were very common. Few of these ever heal without distortion of the face; tedious exfoliations of bone take place, and the fractured extremities occasionally show no disposition to unite by callus."

Hennen (1818) described the treatment, such as it was. He stated that if the bone of the lower jaw was fractured or had sustained a loss of substance, the powerful and opposite muscles rendered it difficult if not impossible to prevent great deformity. The lower jaw should be closely placed in contact with the upper, which must be viewed in the light of a fixed splint, and the part supported by a properly adapted roller over the fractured points. The patient must keep his mouth closed and his food must be altogether fluid. Hennen stated that he had never seen the attempt to save loosened teeth productive of ultimate good.

THE TREATMENT OF CONDYLAR FRACTURES IN THE NINETEENTH CENTURY

The work of Desault extended into the nineteenth century. In a treatise published in 1805 he gave an excellent account of condylar fractures. He had observed that these fractures might occur from a direct as well as an "indirect blow" when the lower jaw was struck. He pointed out the importance of restoring the contact of the fragments, and stated that union might fail to take place if the slightest movement of the jaw occurred. In such cases, he went on to say, the callus produced, being situated near the joint, rendered the condyle irregular and deformed, and this was apt to impede the function of the jaw "from below upward, or before backward against the chin." He knew that the fracture generally occurred below the insertion of the external pterygoid muscle and that this muscle almost always caused a displacement, "the condyle being drawn forward while the body of the jaw is left behind." For treatment of condylar fractures he advised careful reduction, considering two possibilities: First, the one of pulling the condyle back to a normal position, which he stated was impossible; second, pulling the ramus forward, which he recommended.

The reduction, according to Desault, was accomplished as follows: The angle of the jaw was pushed from behind forward. The force was supplied first by the fingers of the surgeon, and was permanently kept by means of a thick compress placed behind the jaw to fill the hollow under the ear, over which a bandage was passed in oblique manner so that it retained the body of the bone in line with the displaced condyle. Feeding, he stated, was accomplished through a space made by the loss of a tooth, and the patient was to avoid talking and laughing. A woman aged 34 years who fell on her chin and was treated by this method, had normal function of the jaw in thirteen days. A slight difficulty in moving the jaw resulted, but was removed by exercises, and the patient was discharged the thirty-sixth day.

Boyer in his *Lectures on Diseases of Bones*, in 1805, stated that great care in retaining the condylar fragments in position was requisite but sometimes impossible to accomplish. He cited a case of a patient treated by a contemporary in the Hôpital de la Charité whom he was asked to see seven or eight months afterwards, because of a fistula in the external auditory canal from which he extracted a bony mass that had the form of the condyle.

Malgaigne in his *Traité des Fractures et des Luxations* published in 1847, also discussed condylar fractures, and cited Ribes, who had observed two cases of double fracture, through the body of the mandible on one side, and through the

neck of the condyle on the other. Lateral distortion of the jaw resulted in spite of the most arduous and skillful attention. He then decided reduction was impossible without effecting the correct position of the condyloid fragment, and recommended the following method, after treating by it a cannoneer who had a similar injury: "With the left hand seize the anterior portion of the jaw, for the purpose of drawing it horizontally forward, while you carry the index finger of the right hand to the lateral and inferior part of the pharynx. You will meet at first the projection formed by the styloid process, but moving your finger forwards, you will find soon the posterior border of the ramus of the jaw; and following this border from below upwards, you will arrive at the inner side of the condyle, which you will push outwards in such a manner as to engage it upon the other fragment. The reduction obtained, bear the jaw upwards and backwards in order to press and fix the condyle between it and the glenoid cavity, then fasten it into place with a sling." In addition, he stated, the pressure bandage of Desault might be applied, or the front teeth of the lower jaw might be wired to the upper to draw the chin forward and maintain apposition, as recommended by Fountain (1860).

Houzelot (1827) reported a case in which both the condyloid and coronoid processes were fractured. Sanson (1844) asserted that fractures of the coronoid never unite but that in spite of this, mastication is not hindered, because the masseter and pterygoid fulfill the office of the temporal muscle.

Complications of Jaw Fractures Described in the Nineteenth Century.—Hamilton (1863) stated that grave results were attributed to lesions of the mandibular nerve. He cited a case reported by Rossi in which convulsions followed, and another described by Flajani in which the patient died in convulsions on the tenth day, muscular contractions having commenced on the fourth day. He rightly doubted that the nerve injury was the cause of these complications.

Alix, according to Malgaigne (1789), described the case of a young man who fell from a height, struck his chin, and sustained a fracture of the jaw which was followed immediately by insensibility; convulsions commenced on the fourth day and death came on the sixth. Boyer stated that if the nerve was torn, the square and triangular muscles of the chin were paralyzed. He noticed this condition in the case of a double mandibular fracture. No doubt the slight contortion of the mouth was due to numbness rather than paralysis. Others in his period noticed insensibility of the lips and chin associated with fractures, which disappeared after a few days. Hamilton mentioned other complications as having occurred occasionally, namely salivation, swelling of the submaxillary and sublingual glands, abscesses, and necrosis. He stated that if the blow was vertical on the chin, bleeding from the ears might follow with injury of the brain, and even fatal coma might result.

THE TREATMENT OF FRACTURES OF THE MANDIBLE IN THE FIRST PART OF THE NINETEENTH CENTURY

The treatment of fractures of the body of the mandible did not progress much in the first part of the nineteenth century. It consisted of ligatures applied to the teeth, bandages, and splints.

Bone Sutures.—Bone sutures for fractures, according to Bérenger-Féraud, had been practiced by ancient doctors of Algiers, but were not used in America, Kinloch says, until 1825 when Kearney Rogers of New York applied the wiring method to fractures of the long bones. This method was used for jaw fractures, Bérenger-Féraud stated, by Flaubert of Rouen (1837), Brainard of Chicago (1854), Kinloch of Charleston (1859), Prestat of Pontoise (1861), Cooper of San Francisco (1862), and Rickerstech of Liverpool (1864). A thread was passed inside the mouth through the gingiva and periosteum.

The case reported by Kinloch (1859) was that of a compound fracture in front of the masseter muscle. Treatment with bandages was not effective; wiring of the canine teeth on each side with strong flax threads gave out on the fourth day, and offered no support to the posterior fragment which was edentulous. He finally administered chloroform and made a submandibular incision, divided the external maxillary artery and vein, and made a drill hole in each fragment. The jaw was brought together with silver wire which was allowed to protrude through the edge of the sutured wound.

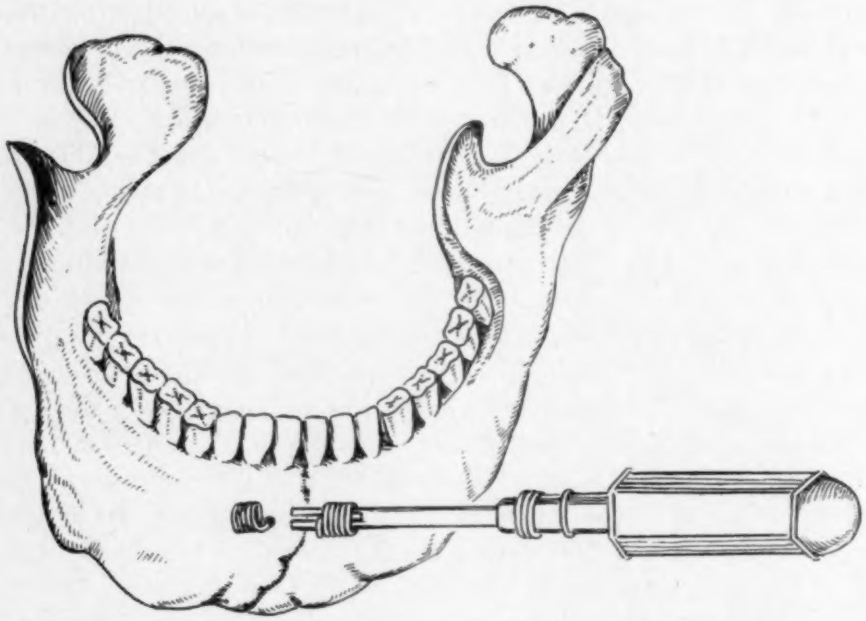


Fig. 2.—Thomas' method of direct osseous wiring. (Cases in Surgery 1869.)

Baudens (1840) used a wiring method different from that described. It seemed to approach the present type of circumferential wiring, but since no splint was used with it, it could be applied only to fractures splitting the bone obliquely. The ligature was passed through the soft parts by means of a needle and carried around the bone, conjoining the fragments when being tightened and knotted upon the teeth.

Thomas (1869) invented a method of bone wiring for compound fractures which allowed adjustments, because, he stated, fractures fixed by ordinary tie became relaxed on the second or third day. The wire was inserted through a

drill hole and passed along the lingual side of the jaw over the fracture to a second drill hole, and emerged on the outer surface. Here it was coiled by means of a key (Fig. 2). The method made it possible to tighten the wire every second day.

In 1847, Buck reported a badly displaced fracture to the left of the symphysis, which he reduced by dissecting off the underlip to restore the bone to its normal position. He drilled holes at the lower angle of the fracture, maintaining it in position by wiring the fragments together. Hamilton, in 1858, got union in three weeks by direct wiring of a fracture at the angle of the jaw, which accidentally resulted from trephining the ramus for the cutting of the "dental nerve" in a patient suffering from neuralgia.

Interdental Wiring.—Ligation of the teeth, however, remained the principal method of treatment. A quotation from a paper by George Hayward (1838), Surgeon to the Massachusetts General Hospital, may be of interest in this respect. He stated: "When the bone is not comminuted and there are teeth on each side of the fracture, the ends of the bone can be kept in exact apposition by passing a silver wire or strong thread around these teeth and tying it tightly. It will be found very useful, also, as an auxiliary in more severe cases, in which it may be required to use splints and bandages. It requires some mechanical dexterity to apply the thread neatly, but in large cities we can avail ourselves of the skill of the dentists for this purpose."

Splints.—The earliest splints were simple interdental splints laid along the crowns of the teeth and only sufficiently grooved to be easily retained in place. Boyer (1805) recommended the use of cork splints, sloping gently backward. Wallace of Dublin (1836) interposed a grooved cork to the posterior fragment, raising the anterior fragment by means of a bandage. He stated, however, that he had seen such treatment result in nonunion, but he agreed with Boyer that it was surprising how little this interfered with either enunciation or mastication.

Gillespie (1836) adjoined a piece of sole leather between the teeth on both sides, and passed one bandage around the head and another around the chin. He claimed that by this method he obtained union without any deformity. Ivory wedges were employed by Muys and Bertrandi (1789). Other splints took on the form of clasps which were applied over the crowns and sides of the teeth, or were made fast by screws; splints were applied to the outer and inner margins of the jaw; and interdental splints were combined with outside splints.

In 1855 the gutta-percha splint was introduced by Hamilton. It was said to have the advantage of stability over cork splints which easily became loosened and disarranged. The gutta-percha was heated, molded into wedge-shaped blocks, and placed on each side between the teeth, which were pressed into it while the jaw was properly aligned.

Bandages.—Bandages were used extensively in this century. Barton (1819) recommended a bandage made of a roller, five yards long. This was passed from the occiput obliquely over the left parietal bone to the top of the head; then

down across the right temple and zygomatic arch beneath the chin to the left side of the face, mounting over the left zygoma to the summit of the cranium, to next regain the starting point at the occiput. Next it was wound around the base of the lower jaw, over the chin, and back to the occiput, and repeated until the bandage was used up. This bandage is still employed today for emergency treatment, as well as an accessory to support the jaw if interdental splints or intermaxillary ligation are used. Hamilton (1857), having noticed that the ordinary bandage was liable to displace the anterior fragment of the jaw backward, devised the apparatus shown in Fig. 3. This, he stated, was capable of lifting the anterior fragment almost in a vertical direction, and there was no strap to pull the chin back.

Fig. 3.—Hamilton's bandage. (From Garrettson.)

THE TREATMENT OF FRACTURES OF THE MAXILLA IN THE EARLY PART OF THE NINETEENTH CENTURY

Lavallée (1854) reported three cases of maxillary fractures to the Société de Chirurgie of Paris. One was complicated with empyema of the antrum. Hiffelsheim (1854) reported another case which involved the orbital margin of the zygomatic angle, causing partial anesthesia of the upper lip. Sargent of Boston, in 1855, reported a severe fracture of both maxillas in which union occurred without the use of any retentive apparatus. Many other articles on maxillary fractures, mostly case reports, were published at this time in the French, German, English, and American literature. Salter (1860) reported a case which is of interest because of the new method of treatment that he used. The upper jaw, which showed great tendency to move out of place, was immobilized by means of a gold plate (denture). Others later constructed plates of vulcanized rubber for this purpose. In this period the use of such appliances was not generally favored, because it necessitated mouth impressions and laboratory work.

THE TREATMENT OF FRACTURES DURING THE WAR OF 1861 TO 1865

In the *Medical and Surgical History of the War of the Rebellion,* Circular No. 6, published by the Surgeon General's Office in 1865, we read that from the beginning of the war to October, 1864, there were 1,579 fractures of the facial bones, of which 891 recovered and 107 died. The terminations in 581 cases were still to be ascertained. In the circular issued in 1870, 3,312 cases of gunshot wounds of the face were reported; of these, 1,617 were fractures of the mandible. Of the 340 deaths which followed these injuries, 121 were cases of mandibular fractures. The death rate following compound fractures of the long bones were very much higher, however, even as high as 75 per cent. Yet if the patient lived, the resulting deformity was very much less embarrassing than was the case in facial injuries. It was stated that secondary hemorrhage was the principal source of fatality in these injuries, for the difficulties in securing the bleeding vessels in this region were very great. Ligation of the carotid artery often helped to postpone the fatal event. It was found that gunshot wounds of the face healed rapidly, and it was stated that necrosis and caries of the bone were inconsiderable compared with the amount of comminution. Many creditable plastic operations for the relief of deformities were accomplished. Numerous casts and photographs of such operations have been collected for the Army Medical Museum. In Circular No. 3 of the Surgeon General's Office, there were described in detail six injuries of the face, two of the maxilla, and seven of the lower jaw. Most of these injuries were due to projectiles impelled by gunpowder. Another facial injury cited was caused by an arrow.

The severity of the disfigurement following some of the more extensive facial injuries has been described in the reports of the examiners on application for pensions at the end of the war: "The saliva constantly dribbles from the patient's mouth. The mouth presents a shocking deformity, which in a great measure excludes him from society" . . . or "The face is so badly disfigured that he will ever be an object of pity, and unable to gain a living except in seclusion from society."

Fractures caused by firearms thus presented a new problem not met with in civilian life. It was an obscure dentist from the South, Dr. J. B. Bean, who made a contribution for the most effective treatment of jaw fractures in the form of a splint used extensively by the Confederates. The apparatus consisted simply of a piece of wood with a chin cup. The wood was $4\frac{1}{2}$ inches in length, $\frac{3}{16}$ inch in thickness, and $1\frac{1}{2}$ inch in width, to which was attached on each side a metallic sidepiece; temporal straps were fastened to these sidepieces (Fig. 4).

In Kingsley's *Treatise on Oral Deformities* published in 1880, we read that, in the North, Hamilton's gutta-percha splint was used successfully for fractured jaws during the Civil War. Dr. St. George Elliot of London, the Assistant Surgeon of the United States Volunteers, said: "I believe from much experience in the treatment of these fractures that there is no material or apparatus that can meet all the requirements as fully as gutta-percha." It is said that Dr. Elliot preferred this type of splint because it had the advantage of being quickly made, and finished at once, and because an aperture could be left to introduce food and to syringe out discharges.

The use of the gutta-percha splint was recommended in ***The Surgeon's Pocketbook*** (British) written by Surgeon-Major Porter (1875), who stated that because mandibular fractures, which were numerous and troublesome, were difficult to reduce and maintain in position, the gutta-percha splint was recommended.

Fig. 4.—Bean's splint, War of the Rebellion. (From Garrettson.)

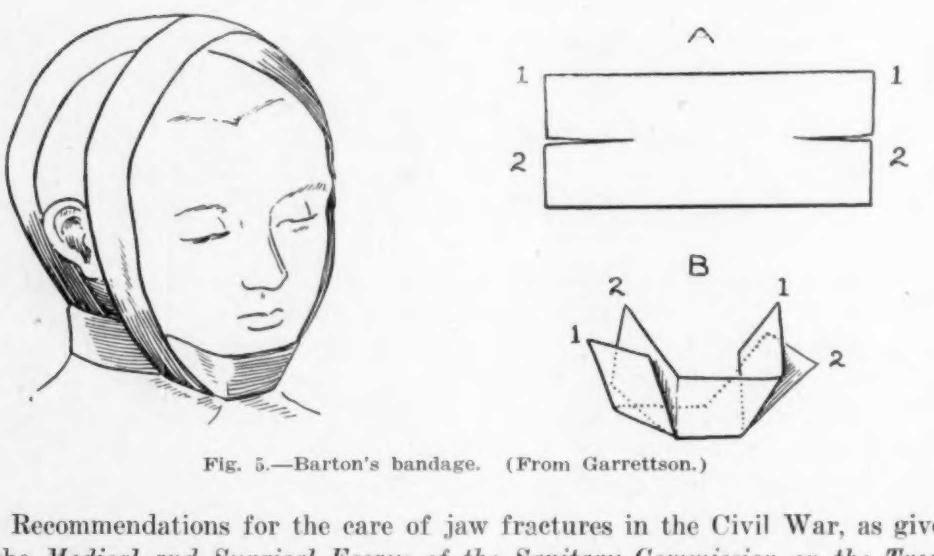


Fig. 5.—Barton's bandage. (From Garrettson.)

Recommendations for the care of jaw fractures in the Civil War, as given in the ***Medical and Surgical Essays of the Sanitary Commission on the Treatment of Fractures in Military Surgery*** (1862), were as follows: "Fractures of the lower jaw are best treated by means of a bandage described by Dr. Barton (Barton, 1819): 'Slit up a bandage 3 inches wide and one yard long from each end to within 3 inches of the center. Apply this over the jaw. The two tails on either side are crossed over each other and the corresponding ones tied top and back of the head.' A cap of pasteboard, folded paper, or plaster of Paris may be made for the chin (Fig. 5). If time permits, the coaption of the frag-

ments may be further insured by enclosing the teeth adjoining the injury in a loop of fine wire twisted together. The extraction of a tooth to take food is seldom necessary."

THE INTERIM BETWEEN THE CIVIL WAR AND WORLD WAR I

In this period the dentists took a hand in developing new methods for the treatment of fractures of the jaws. Hamilton's gutta-percha splint, already described, had possibilities which were promptly grasped by the ingenuity of the mechanically inclined members of the dental profession. As we will see later, new splints were originated as soon as new methods, such as the vulcanizing of rubber, the swaging of metal, and the casting process, became available.

This development was almost entirely along the lines of prosthetic dentistry, and as late as 1911, when I graduated from Harvard Dental School, the fracture cases were treated in the Clinic for Prosthetic Dentistry rather than by the Oral Surgery Department.

TREATMENT OF MANDIBULAR FRACTURES

The methods of stabilizing fractures used during this period may be classified as follows:

- Horizontal and intermaxillary ligation
- Prosthetic appliances
  - Intraoral appliances
    - Immobilizing the mandible
    - Not immobilizing the mandible
  - Combined intraoral and extraoral appliances

Horizontal Wiring.—This method, first used by Hippocrates, underwent some changes. The new method consisted of attaching individual wires to two teeth on each side of the fracture line. The twisted wire on the nearer tooth on one side was united with the wire on the further tooth on the other side. Both wires were tightened across the outer surface of the teeth (Fig. 6).

The Essig Method.—Another method was that used by Essig, in which an annealed brass wire was laced around the necks of the sixth, the fifth, and the fourth tooth away from the fracture. When the third tooth from the fracture was reached, one end of the wire was passed along the labial side, the other pulled straight across the lingual arch, and then laced again around the fourth, the fifth, and the sixth tooth on the other side of the fracture. Secondary wires were passed between the teeth and twisted so as to bring the wire on the lingual side close to the dental arch and thereby effect close approximation of the fragments, stabilizing the broken bone without immobilizing the mandible (Fig. 7). This method was, of course, useful only in cases of simple fractures within the dental arch.

Intermaxillary Ligation.—This method was perfected by Gilmer in 1887. He described a method by which teeth were ligated individually, and corresponding ones in the upper and lower jaws fastened together so that the mandible was drawn into occlusion with the maxilla, and held in position until the fracture had healed (Fig. 8). A variation of this method was that in which the wires from a

posterior upper tooth were fastened to one further forward in the lower jaw, and vice versa, namely, a posterior mandibular tooth fastened to an anterior maxillary one. In this method the twisted wires crossed each other and prevented forward and backward gliding of the jaw if the patient had worn down the cusps of the teeth and had a so-called edge-to-edge bite (Fig. 9).

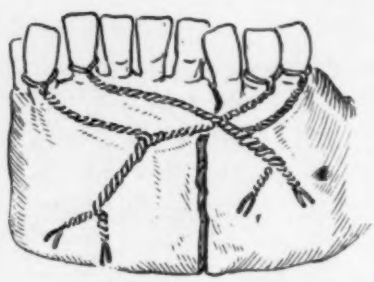


Fig. 6.—Horizontal wiring.

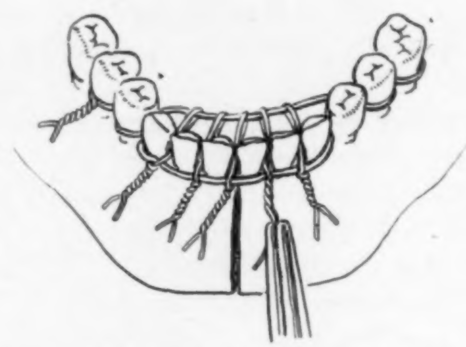


Fig. 7.—Essig method of horizontal wiring.

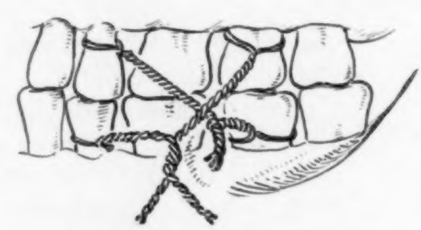


Fig. 8.—Gilmer's method of intermaxillary ligation.
Fig. 9.—Intermaxillary ligation with wires crossing.

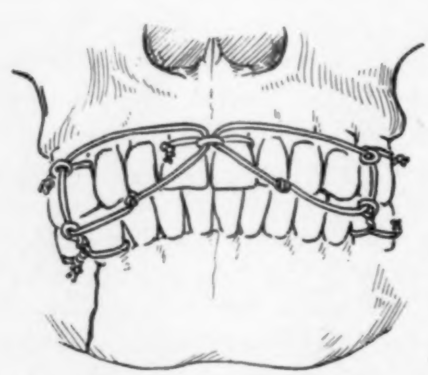


Fig. 10.—Oliver's method of intermaxillary ligation. (J. A. M. A. 54: 1187, 1910.)

Gilmer Arches.—Gilmer (1907) described a second method, the arch bar method of wiring, in which a German silver wire was bent to conform to the shape of the dental arch. The arch bar was wired to the individual teeth both in the upper and the lower jaws, after which the arches could be fastened by secondary wires to hold the teeth in occlusion.

Oliver Method.—Oliver (1910), Dental Surgeon of the United States Army, recommended the use of soft, 20 gauge annealed copper wire for intermaxillary wiring. He advised a method which prevented both lateral and perpendicular mobility. It consisted of attaching an anchor loop to the central incisors and another to the molars. These were made by inserting a wire with an eyelet in the middle between the teeth, and passing each end around the adjoining tooth, twisting them together in front. A traction wire was passed from the eyelet in the median line of the maxilla to the eyelet in the lower molar region. Vertical wires could be attached to hold the teeth in occlusion (Fig. 10). From this method the eyelet attachment used today was derived.

Intraoral Appliances.—The gutta-percha splint was still championed by Hamilton in a lecture on fractures of the lower jaw delivered at the Bellevue Hospital in New York (1878). He recommended its use together with a vertical bandage around the head for fractures occurring within the dental arch. The first splint made out of vulcanized rubber was described by Sands of New York in 1863.

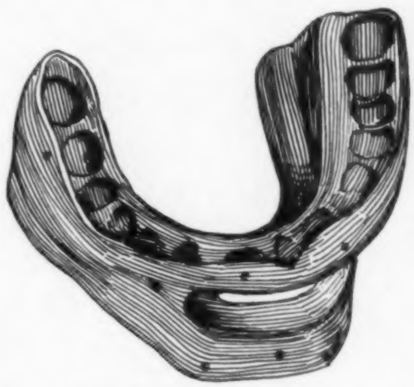


Fig. 11.—Gunning splint. (From Garrettson.)

Gunning Splint.—This well-known interdental splint was invented, according to Clarke's *A Century of Medicine,* almost simultaneously by Dr. Gunning (1866) of New York and Dr. Bean (1866) of Georgia, although the appliance is generally known as the Gunning splint. Gunning wrote: "On February 12, 1861, I applied a hard vulcanized rubber splint to the fractured jaw of a seaman in the U. S. Naval Hospital." The construction of this splint involved the taking of impressions of the upper and lower jaws, whether or not the teeth were present. Casts were made, and after sawing the model of the mandible apart at the site of the fracture, it was so adjusted as to effect normal alignment, and, if the teeth were present, normal occlusion. The casts of the upper and lower jaws were then put on an articulator in order to make a model of the splint in wax, fitting the upper and lower jaws so they were partly open, allowing a hole for feeding in front (Fig. 11). The wax was then duplicated in rubber and the splint inserted and held by a bandage around the face (Barton bandage). Later, similar splints were made in metal.

Single Splints.—In order to overcome the disadvantage of splinting the mandible to the maxilla, numerous dental splints were devised and used to

stabilize the fracture by an appliance attached to the mandibular dental arch alone. The splint devised by Sands (1863) was of this type (Fig. 12). Instead of being fitted both to the upper and lower jaw as was Gunning's splint, it was attached only to the mandible. Pegs or wires extending between the teeth, through holes drilled in its inner and outer flanges, were used to hold the splint in place and to stabilize the fracture.

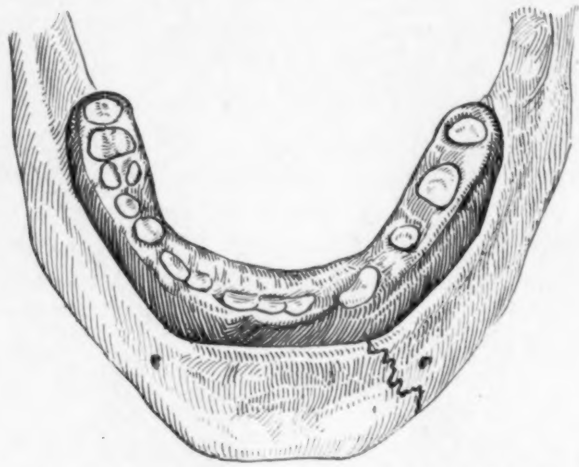


Fig. 12.—Rubber splint for mandible. (After Piperno.)

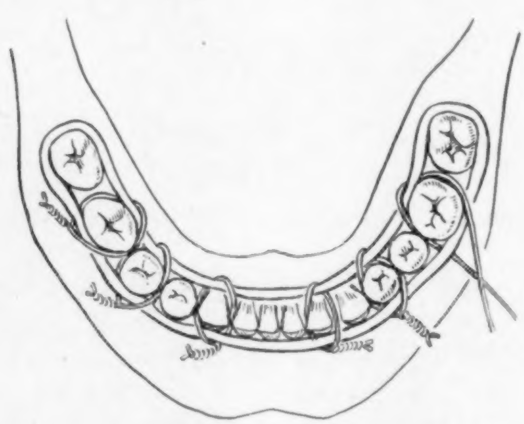


Fig. 13.—Hammond's wire splint. (From Piperno.)

The Hammond Splint.—Hammond (1874) devised a simple method of shaping a gold or German silver wire around both the outside and inside of the dental arch, bringing it in close contact with the necks of the teeth. Fine wires were passed between some of the teeth to connect the outer and inner parts of the arch wire and prevent it from being displaced (Fig. 13).

Swaged and Cast Splints.—Metal splints were later made of German silver or gold by swaging over metal casts made from impressions of the jaw taken with the fracture reduced. These splints were filled with cement, and pressed over the teeth while the fracture was reduced. The cement held the splint in place, thus stabilizing the fracture while healing was taking place. When the

casting process became perfected for use in dentistry, cast splints were made of silver (Weiser, 1905), or aluminum (Beeson, 1910).

It was a disadvantage that it was not possible to observe the correct position of the teeth when these splints were wired or cemented into place; therefore, splints were constructed with the cusps of the teeth protruding, allowing them to occlude with the maxillary arch.

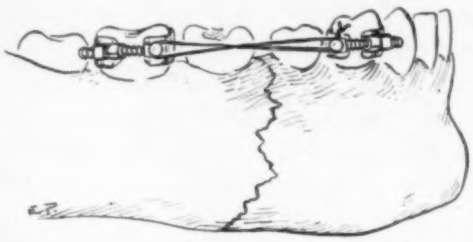


Fig. 14.—Angle bands and horizontal wire.

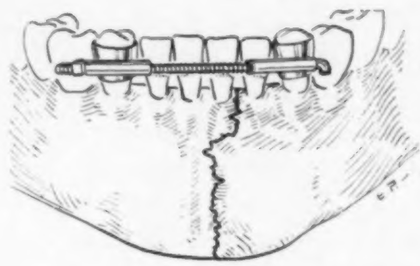


Fig. 15.—Angle bands with tubes.

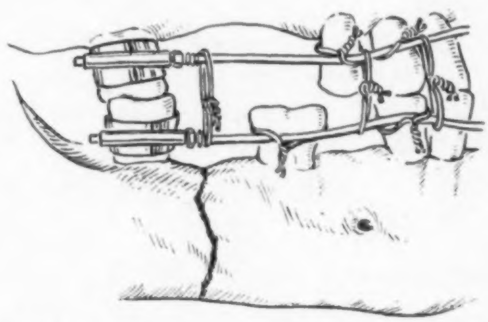


Fig. 16.—Angle bands with Gilmer arches for intermaxillary fixation.

The Angle Method.—Angle (1890), a pioneer in orthodontics, also contributed much to the treatment of fractures. He devised special bands that could be placed around the teeth instead of wires, these bands being fastened simply by turning a nut. The bands had little knobs around which wires could be passed to pull a posterior tooth against an anterior one, and held the fractured mandible in firm contact (Fig. 14). He also used ordinary bands with tubes attached on the outer surfaces for inserting arch wires across the fracture line (Fig. 15). For intermaxillary fixation when all the teeth were not present, Angle bands could be fastened to the molar teeth on each side to attach a long arch wire, inserted into the tubes on these bands, and fastened to the remaining teeth with wires. Ligatures passed between the arch wires were used to hold the upper and lower teeth in occlusion (Fig. 16). This method is still in use today.

Intraoral and Extraoral Appliances.—More complicated appliances were devised by inventive geniuses from time to time. Most of these have only historical interest today.

The Sudduth Splint.—Sudduth devised a mentodental splint which consisted of a dental tray filled with impression compound made to fit the mandibu-

lar dental arch. When applied to the jaw, it was forced into the estimated correct position by means of a cup containing a little plaster, which extended under the chin. The plaster, when hard, fit equally on all sides. Two adjustable clamps held the two parts in position. It was claimed by Sudduth that this splint was universal in application, that by its use a perfect articulation was assured, and that it had the advantage of cleanliness and comfort in wearing. Being easy to adjust, it insured absolute firmness so that no crepitation could occur (Fig. 17).

The Kingsley Splint.—Kingsley (1880) of New York used a horseshoe-shaped metal tray fitting the lower dental arch. Two strong wires were soldered to it to extend out of the mouth so that a bandage could be carried from one to the other, back and forth, passing beneath the mandible. The tray was filled with heated gutta-percha and placed over the mandibular teeth. The wires were bent close to the face, and allowed to extend as far back as the ears (Fig. 18). The intraoral part of the splint was supposed to push the short fragment down while the bandage acted to press the long fragment up, bringing the fracture into proper relation. The fact that the occlusion could not be observed was a decided disadvantage.

Other Types of Splints.—Another mandibular splint on the principle of that of Kingsley's was described by Martin of Lyons, France. Still another on the Sudduth principle had one central clamp instead of two. An ingenious but more cumbersome splint was designed by Moriarty of Boston, who was demonstrator in mechanical dentistry at the Harvard Dental School from 1890 to 1900. This is shown in Fig. 19.

TREATMENT OF FRACTURES OF THE UPPER JAW

Hamilton (1863) stated that these fractures were so varied that it would be impossible to speak of them systematically, or to establish anything but very general rules as to treatment and prognosis. He recognized that they generally were complicated with fractures of other bones of the face or with the base of the skull. He described a case of a patient who was thrown from a cart, the wheel passing over his face. He became unconscious, and when he was examined he was found to have fractured both maxillas. These were loosened from their bases, and the malar bone had been forced into the antrum. The patient was treated with cool lotions to the face, and although no attempt at reduction was made, all motion of the fragments had ceased on the ninth day and the patient had completely recovered on the twenty-seventh day. Hamilton cited another case, complicated by severe injuries, in which the maxillas had been completely torn from their connections. He found it necessary to support the fragments by closing the lower jaw upon the upper by suitable bandages. However, this patient died on the twelfth day.

Diagnosis.—Guérin (1866) was the first to recognize certain diagnostic signs of horizontal fractures of the maxilla. These, he stated, were: (1) Mobility of the fragment; (2) constant pain, increased when moving the loosened part; and (3) ecchymosis of the palate and face. The complete horizontal fracture above the floor of the antrum has since been known as Guérin's fracture, especially in the foreign literature.

Fig. 17.

Fig. 18.

Fig. 17.—Sudduth splint with external fixation. (From Garrettson.)
Fig. 18.—Kingsley splint. (From Morgan, J. A. D. A. 21: 1739, 1934.)

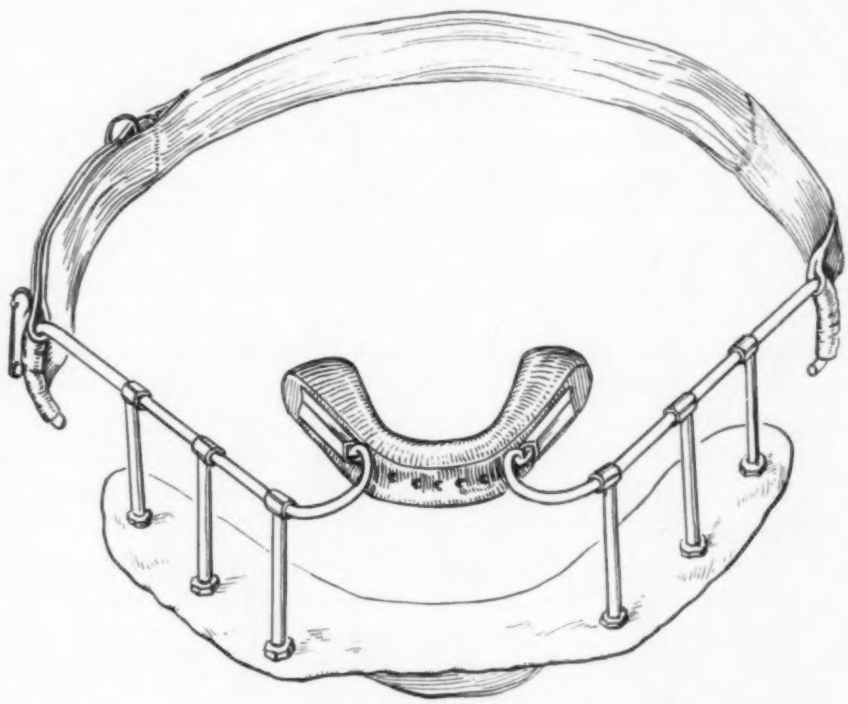


Fig. 19.—Splint for mandibular fractures designed by Moriarty of Boston. (Harvard Dental School Museum.)

As late as 1895, Garrettson wrote that fractures of the upper jaw occurred rarely and only from extraordinary causes. Though he had treated a number of cases, he had met, in no instance, a displacement requiring a special apparatus for its cure, although he admitted that cases on record showed that if the injury was great enough, the bones were luxated en masse. He then described cases in which bone necrosis occurred, or in which comminution was so severe that numerous splinters had to be removed, "the hiatus" being fitted with a prosthesis containing the anterior teeth, "which happily restored the continuity."

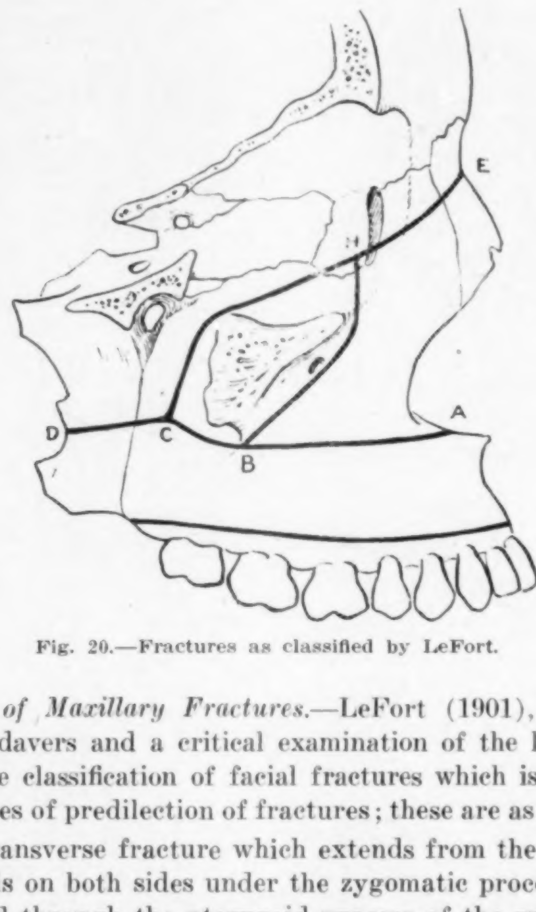


Fig. 20.—Fractures as classified by LeFort.

Classification of Maxillary Fractures.—LeFort (1901), after a thorough examination of cadavers and a critical examination of the literature, gave the first comprehensive classification of facial fractures which is still in use today. He found three lines of predilection of fractures; these are as follows:

1. Guérin's transverse fracture which extends from the lower level of the apertura piriformis on both sides under the zygomatic process to the pterygopalatine fossa, and through the pterygoid process of the sphenoid bone (Fig. 20, *A, B, C, D*). The lower fragment is generally very loose and may be dislocated backwards.

2. A line which begins at the nasal bones, passes through the frontal process of the maxilla, lachrymal bone, orbit, and from the anterior end of the orbital fissure through the malar process, remaining inside and below the malar bones (Fig. 20, *E, H, B, C, D*). The septum is involved, and the middle portion of the face is dislocated.

3. The third line is like the second at the beginning, but it does not divide the maxilla from the malar bone; it takes in the latter by passing through its frontal process and the zygomatic arch (Fig. 20, *E, H, C, D*). It separates the facial bones from the cranium above the malar bones.

Rule for Treating Facial Fractures.—The rule, "that all fragments, however slightly adherent they may be, ought to be most carefully preserved," was set forth by Malgaigne, and was repeated by Hamilton as a principle which surgeons should keep foremost in their minds.

Hamilton (1871) stated that many fractures of the upper jaw can be reduced by putting the thumb under the zygomatic process within the mouth. If this was not possible, he recommended the use of a strong blunt hook introduced through a small incision on the cheek into the malar bone. In other cases a suitable instrument was inserted into the antrum through the socket of a tooth dislodged during the accident, or a socket of a recent extraction that had not quite healed. He did not approve of the extraction of a tooth as had been recommended by others for this purpose, because the force needed might dislodge fragments of bone, and even cause the loss of the entire floor of the antrum. If no tooth socket was available, he advised drilling a hole through the anterior wall of the antrum so as to be able to introduce the instrument.

Stabilization of Maxillary Fractures.—For stabilization of maxillary fractures, bandages were first used. A new method was recommended by Goffres (1862). He used a headband with two arms extended over each side of the nose, and so bent as to enter the mouth for support of the incisor region. Graefe (1879) also extended two arms by means of a headband, but these entered at the corners of the mouth. The appliance supported the maxilla in the premolar region. Ferraton (1909) described a more complicated splint consisting of the headband and two metal rods extending into the mouth to engage a rubber splint made for the upper jaw. This was similar to what is known in this country as the reversed Kingsley splint.

The Reversed Kingsley Splint Still in Use Today.—This splint was designed for the treatment of complete horizontal fractures of the maxilla. It was constructed by vulcanizing a tube into each side of a rubber splint, such as that devised by Gunning. The idea of the tube came from Marshall, and to Kingsley is accredited the addition of "wings," that is, wires extending from the mouth, bent around to follow the outline of the cheek. The bandage is applied over the head, holding the maxilla firmly against its base from which it has been detached. A plaster cap or headband may be used instead; either allows better adjustment than the bandage. The obvious fact that the apparatus does not allow us to observe whether the upper teeth are in the same horizontal plane as the lower ones, is an important disadvantage; if there is angulation after the fracture has healed, the teeth will come in contact on one side and not on the other.

THE TREATMENT OF FRACTURES DURING WORLD WAR I

One of the features of World War I was trench warfare, as a consequence of which the upper part of the body chiefly was exposed to injury, particularly the head and face. This, combined with the destructive effect of high explosives and bullets, shells, and hand grenades, caused comminuted compound fractures and mutilated faces in many of the casualties, such as rarely had been seen before. The surgical skill and mechanical ingenuity of those who served with the armed forces was put to a test. Since shattered jaws and

lacerated skin, if not properly treated, not only cause inability to masticate food properly but result in disfigurement, the surgeon had to develop new methods to improve the treatment of fractures, and plastic operations to enhance the cosmetic result. This was not only important but necessary, since those injured and maimed might be looked at temporarily as heroes, but later would be certain to become objects of dread and loathing to their fellow men.

Fig. 21. Fig. 22. Fig. 23.

Fig. 21.—Gunshot wound caused by projectile entering near left side of the nose, where it caused a small wound, and produced laceration of the face and compound fracture of the mandible.

Fig. 22.—Fourteen days after fracture was reduced and wound partly sutured.

Fig. 23.—Condition when discharged from hospital with complete union of fracture. (Figs. 21 to 23 from Kazanjian, Am. J. Orthodontics and Oral Surg. [Oral Surg. Section] 28: 265, 1942.)

WAR WOUNDS OF THE FACE

Description of War Wounds.—Eloesser (1917) wrote that the war not only had developed much that was new, but had brought back much that was old. He stated that wounds were of a varied nature; those caused by knife, bayonet, and saber very rarely involved the face, while bullets, shells, and shrapnel frequently struck this part. Bullets might cause small wounds of entrance and exit, but great destruction in between. He believed, however, that every bullet was a dumdum bullet potentially; it might hit something on the way or something in the body. If it hit bone and shattered it, each fragment became a secondary missile which tore, crushed, and bruised the adjacent parts. If it hit sidewise, it produced a much larger external wound and caused extensive lacerations. The shell which broke into a multiude of small, jagged pieces inflicted wounds that were dangerous and became infected. Shrapnel was a combination of the shell and the bullet; the bullets were of lead, and were readily distorted and spattered around in the wound to lodge permanently in the body. Eloesser stated that burns and powder marks were frequently associated with wounds of

the face, and while these might have serious sequelae, it was infection and hemorrhage that were the principal dangers of gunshot wounds. To show the type of wound frequently seen in World War I, illustrations from one of V. H. Kazanjian's articles are included here (Figs. 21, 22, and 23).

The fractures which accompanied these injuries differed markedly from those seen in civilian life; they were characterized by comminution and loss of bone. The cavities of the face were frequently opened and filled with foreign bodies. The fragile walls might have been shot away, and the contents of the orbit might have dropped. The mandible being denser, but more loosely articulated, was often completely shattered into numerous pieces. The entire bone or parts of it might have been shot away and have left vast defects. All writers on war surgery pointed out the importance of saving all the bone that remained attached, even if held only by a thread of the periosteum, and of preserving the soft parts as well. It was observed that, because of the unusually good blood supply to the face, such tissue would survive and facilitate future plastic operations. Marshall (1917) wrote that it was surprising how readily little pieces of bone would unite and form a considerable plate of bone, if manipulated into place with proper instruments.

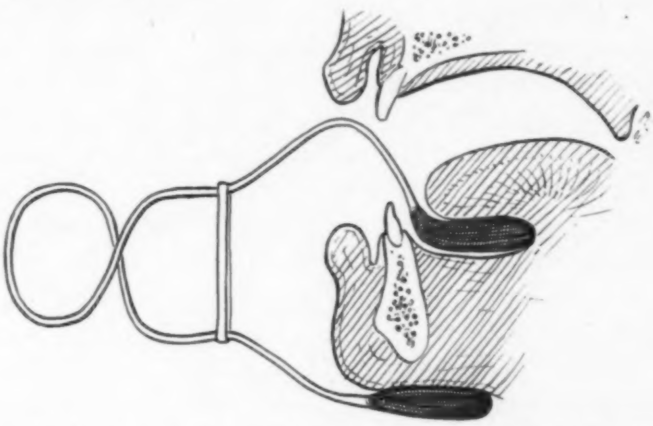


Fig. 24.—Kazanjian clamp to arrest hemorrhage from the floor of the mouth.

Hemorrhage.—Bleeding from such wounds as described often presented grave problems. Kazanjian (1917) stated that some hemorrhages were successfully treated by packing, clamping, or ligation. He described a clamp for the arrest of hemorrhage from the floor of the mouth, which was very effective for stopping bleeding from the lingual artery (Fig. 24).

Infection.—According to Valadier (1917), grave local and general sepsis, producing septicemia, meningitis, general pyemia, and mediastinitis occurred only occasionally. Among 1,010 cases of face and jaw injuries, there were twenty-seven deaths. Kazanjian (1917) stated that one-fifth of the patients with jaw fractures developed bronchitis and bronchopneumonia. Local infections of either the soft tissues or the bone were found more frequently, however. Vancresson (1916) mentioned that late infections of the bone had the greatest analogy to prolonged osteomyelitis. Generally there was a chronic fistula leading to an area of bone necrosis, a sequestrum, or foreign body. These were

located by x-ray examination. Infections were generally treated by continuous, multiple deep irrigations, and especially by the Carrel-Dakin method (Sweet, 1917; Dakin et al., 1917) for which excellent results were claimed. Fisher (1916), at the suggestion of Dakin, used a 2 per cent aqueous solution of chloramine for wounds of the mouth and jaws. The solution was injected every hour through tubes inserted through the wounds to the infected area (Fig. 50). Others, however, preferred the use of antiseptic pastes. Morrison (1917) developed a treatment which was a modification of the use of Beck paste. The paste was made of the following:

Bismuth subnitrate, 1 part	8 oz.
Iodoform, 2 parts	16 oz.
Paraffin, g.s. to make a soft paste	8 fl. oz.

The paste was placed into the wound and covered with a dressing. Black (1919) mentioned the following advantages: it required no redressing, except after a long period; there were no solutions to soil the bed; and the paste was especially applicable in fracture cases where splints were necessary.

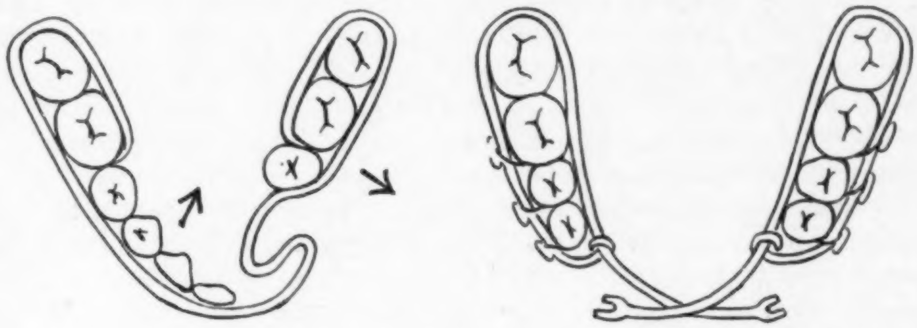
As was pointed out by Sir Berkeley Moynihan (1917), surgeons in World War I were well aware that, in addition to antiseptics, thorough mechanical exposure combined with perfect cleansing was "the supreme necessity in all cases." This included excision of all contaminated, infected, and dead parts, as well as removal of all foreign bodies. In addition, full emphasis was laid on the paramount importance of complete immobility of injured parts. This treatment was carried out with modifications, and specifically emphasized by Valadier, Kazanjian, Ivy, and others. Trotter (1918) stressed early treatment with full surgically secured access to the fracture in order to limit hemorrhage, sepsis, and necrosis, and to obtain a limited and relatively aseptic scar.

Reduction and Immobilization of Fractures.—It was recognized that fragments should be fixed in correct position as soon as possible; articles dealing with this subject are numerous. Rubbrecht (1916), who was attached to the ambulance *Ocean* of the Belgium Red Cross, believed in using retaining appliances divided into two or more parts (as many as there were principal fragments), which were then reduced by intermaxillary force by the use of metal and occasionally rubber ligatures. Pope (1917) described an ingenious apparatus for stabilization of the mandible in case of loss of part of the ramus and angle of the jaw. Harrison (1917), Dental Surgeon to the Anglo-Russian Hospital, published a very interesting article describing easily constructed wire splints to be used chiefly in first-aid treatment in field hospitals. These splints were designed by Tigerstedt of Kiev, and were easily made of German silver wire. Corrections of the fractured parts were made either by means of elastics, or by bending the wire with pliers. Many examples were given of which two are reproduced (Figs. 25 and 26).

Ivy (1918), in a collective review, stated that the metal band and wire splint were in general use for the fixation of the fragments of the mandible in their normal position in relation to the upper teeth in the majority of cases of gunshot fractures. These appliances consisted of stout wire spanning the gap where

teeth or tissue had been lost, and they were attached by crowns or bands to sound teeth.

Splints and appliances of various types were described by almost all writers of this period. Some of them deal with this subject predominantly. Dolamore (1916) made a plea for the early use of splints in cases of multiple or single simple fractures, as well as in fractures accompanied by destruction of bone and



Figs. 25 and 26.—Wire splints for first-aid treatment. (After Tigerstedt, Kiev, Russia.)

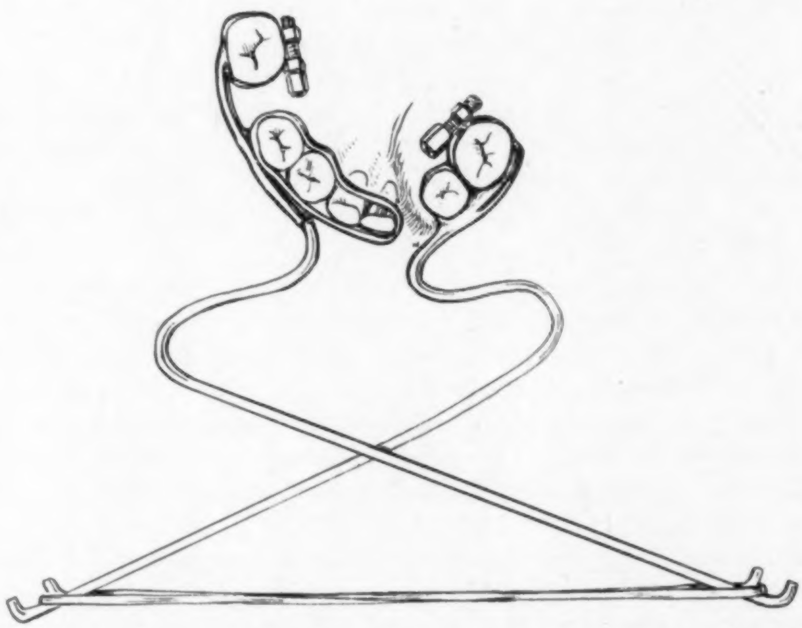


Fig. 27.—Splint with extension arms for elastic traction. (After Hopson, Brit. D. J. 37: 359, 1916.)

overlying soft tissue, to prevent facial deformity in anticipation of later plastic operations. Hopson (1916) included the use of elastic traction on interdental splints, applied with long arms used as levers, and extending out of the mouth (Fig. 27). He also recommended stretching and sliding plates to force the jaw into occlusion if there was lateral deviation.

During the first episode of World War I, the War in Serbia (1914-1915), Poulio (1919) emphasized the importance of perfect fixation with the teeth in

normal occlusion. For fractures consolidated in a false position he recommended "cleavage" and fixing the fragments anew in proper alignment. If, after perfect fixation, with suppuration eliminated, consolidation did not occur after three months, pseudoarthrosis resulted; this, he stated, could be eliminated only by means of a bone graft.

The care of patients at a casualty clearing station was discussed by Mendelson (1918). It consisted first of the primary treatment for shock, hemorrhage, and respiratory obstruction such as is often caused by edema of the tongue, lips, and floor of the mouth. Next came treatment to prevent secondary complications such as pneumonia and local sepsis. Then douches of saline solution were given at least every two hours, local antiseptics were applied, and the parts were put at rest with splints and chin supports. A thorough examination was made, including roentgenograms to locate the presence of foreign bodies, to determine the number and types of fractures, and to locate the presence of roots of teeth between the fractured parts. The cases were divided into those that could be splinted with ready-made appliances, and those that required a specially constructed apparatus. In the clearing station only a foundation could be laid for further treatment.

Reports from the *Dublin Base Hospital No. 83 at Boulogne* were published by Valadier, a Frenchman serving as a medical officer in the British Army. Valadier and Whale (1917) reported on 1,010 cases of jaw and facial injuries. Illustrations of twelve cases of serious injuries demonstrated how gradual progress was achieved through the use of ingenious splints, the careful preservation of valuable tissue, and the patient's waiting for the right time to present himself for the successive steps of the surgical procedures. In general, these authors concluded that the primary closure of the wound is undertaken too late and all subsequent stages are undertaken too early.

The *Department of Oral and Plastic Surgery at Queen's Hospital, Sidcup, England,* had, as surgeon-in-chief, Gillies (1920), whose work embraced some of the most remarkable facial restorations done during the war. He published the results of his early work with King in 1917 and 1920. His monograph *Plastic Surgery of the Face* is a classic. In his hospital, which was placed on an "Imperial basis," Gillies had the cooperation of Waldron and Risdon (Canadian Section), Newland (Australian Section), and Pickeril (New Zealand), as well as Blair, who arrived in 1918 with an American contingent among which was Ferris Smith. Blair published his own experiences with face and jaw injuries in 1920. Fry was the chief dental surgeon and wrote a chapter on the use of prostheses in relation to plastic surgery for Gillies' book.

At the *Southern General Hospital, Birmingham, England,* Parrott (1918) wrote that practically all cases arrived in a state of sepsis, more or less acute, so that irrigations and dressings to prevent extension of the infective process had to be used. Trismus caused by wounds was general and presented a serious obstacle to the preparation and insertion of splints. Trismus was treated with mouth gags and spring clothes pegs, or by stretching under nitrous oxide anesthesia, and if due to deep cicatrix, by surgical division of the strands of scar tissue. Grandison (1918) gave valuable information on the diet and feeding of the patients.

At the *Croydon War Hospital,* 166 beds were entirely devoted to jaw cases when Colyer (1916) wrote his first paper dealing with 204 cases that were under treatment during the first six months after the opening of the hospital. This paper is well worth studying for its valuable case reports, and a second paper by Colyer (1917) is probably one of the most elucidating documents on jaw surgery coming from Great Britain. In contrast to other writers, Colyer justified the "sacrifice of teeth" in the region of the fracture, "because," he stated, "they present a focus of infection which considerably increases the chances of nonunion. . . ." He pointed out that many cases of delayed union were due to neglect of the most elementary surgical principles, such as direct wiring in septic comminuted fractures and failure to remove the cause of sepsis. He gave cases to illustrate that, in comminuted fractures, the teeth near the fracture line had caused delay in union and that union occurred when they were removed. This, he stated, justified the practice at the Croydon Hospital of removing any source of infection at the earliest possible moment. Colyer discussed the treatment of (a) fractures in the anterior part, (b) fractures in the posterior part, (c) severe fractures of the body of the mandible, (d) cases involving considerable loss of the mandible, and (e) fractures of the ramus.

In the *Chaptal and Lariboisiere Hospitals in Paris,* Sebileau (1917), whom Brophy called the untiring, highly skilled surgeon who worked by night and day, did some excellent work with Lemaire and Villain (1917), who cooperated with him in devising many appliances for the immobilization of the bone fragments of the jaw. In a very fine article Sebileau (1917) pointed out that there was a great difference between the treatment of jaw fractures and fractures of the long bones. He stated that the site of the fracture should not be opened externally, and that the removal of bone splinters was contraindicated. Jaw fractures generally were widely opened and well drained by their own pisposition, and constantly flooded by saliva which exercised a beneficial chemotactic action. The article dealt, however, principally with fibrous union and nonunion of fractures, which he stated should be treated by single or double osteotomy. This was performed by both external and intraoral incisions through which a Gigli saw was used. He stressed adequate retention by splints and, when necessary, bone grafting to achieve a satisfactory result.

In the *Second Northern General Hospital, Leeds, England,* injuries of the face and jaws were treated by Munby, Forty, and Shefford. A report of 200 cases was published by them (1918) in which they cited the quotation, "The excellence of every art depends upon the complete accomplishment of its purpose." Judging by the final disposal of their patients, their methods have been justified. Of 200 men, 87.5 per cent returned to duty, 6.5 per cent were discharged from the Army, 3.5 per cent were transferred to other hospitals, 2 per cent were admitted as pensioners, and 0.5 per cent died. Shefford (1919) described the management of these cases. Sepsis was controlled by constant lavage and by the earliest possible treatment of the fractures. Following Colyer's recommendation, teeth were extracted when involved, except in cases in which tissue loss was considerable and bony union unlikely. It was recognized that the power of comminuted particles of bone to generate fresh bone

tissue is remarkable, and that therefore these particles should be retained to help in the process of ossification and consolidation.

The Harvard Surgical Unit, which was formed in June, 1915, counted Kazanjian among its members. He was made chief of the dental section and was assigned to General Hospital No. 22, British Expeditionary Forces; later he was transferred to General Hospital No. 20. Kazanjian wrote many articles which were published in the English (1916, 1917, 1918), the French (1916, 1917, 1918), and the American (1917, 1919, 1920) literature; one of his best early publications is found in the War Supplement of the British Dental Journal (1916). He based his treatment on a classification of fractures, which is as follows:

1. Mandibular Fractures
    a. Simple fractures anterior to the last existing tooth
    b. Multiple fractures anterior to the last existing tooth
    c. Fractures posterior to the last existing tooth
    d. Fractures with missing bony tissue of considerable size
2. Maxillary Fractures
    a. Simple fractures of the alveolus
    b. Partial fractures of the maxilla
    c. Fractures with perforation
    d. Fractures of the entire maxilla
    e. Fractures with loss of bony tissue

Kazanjian obtained exceptionally fine results in comminuted fractures and gunshot wounds accompanied by extensive soft-tissue destruction. He performed some of the most remarkable plastic operations undertaken during the war, and effectively restored horribly mutilated faces. Kazanjian (1920) emphasized the value of various types of prosthetic appliances, which he inserted immediately after the injury to support the tissues while they were still soft and flexible, and to prevent undesirable adhesions. Kazanjian's extraordinary success with badly comminuted fractures was based on the method of suturing osseous splinters. This procedure was described in *Ash's Monthly* (1918) and the *Journal of the American Dental Association* (1919). Sutures were made through the exposed fragments of bone in the mouth; these were then assembled by attaching them to a wire or bar fastened to the teeth, as shown in Fig. 28, or to a bar extended from a headband (Fig. 29). Even though approximation was not possible everywhere, if there was contact the probability of junction was very good. The wire sutures were removed after three to four weeks, and a chin cap was used to counteract the pull of the depressor muscle on the not yet too solid bone. Kazanjian stated that this method safeguarded the facial contour and enhanced the result of later plastic operations, some of which were described in the International Journal of Orthodontia (1920).

Kazanjian's article in the *Journal of the American Dental Association* (1919) on the early suturing of wounds of the face is very instructive. He described the unfortunate results of injudicious primary suturing, but stated that there was a broad scope for early secondary suturing (from five to twelve days after injury) when the bony fragments have been fixed and sepsis has been controlled.

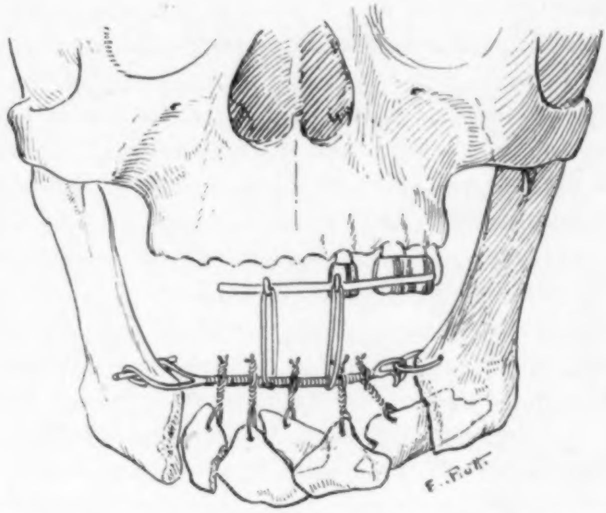


Fig. 28.—Kazanjian's splint for comminuted mandibular fracture. (From Kazanjian, J. A. M. A. 73: 1268, 1919.)

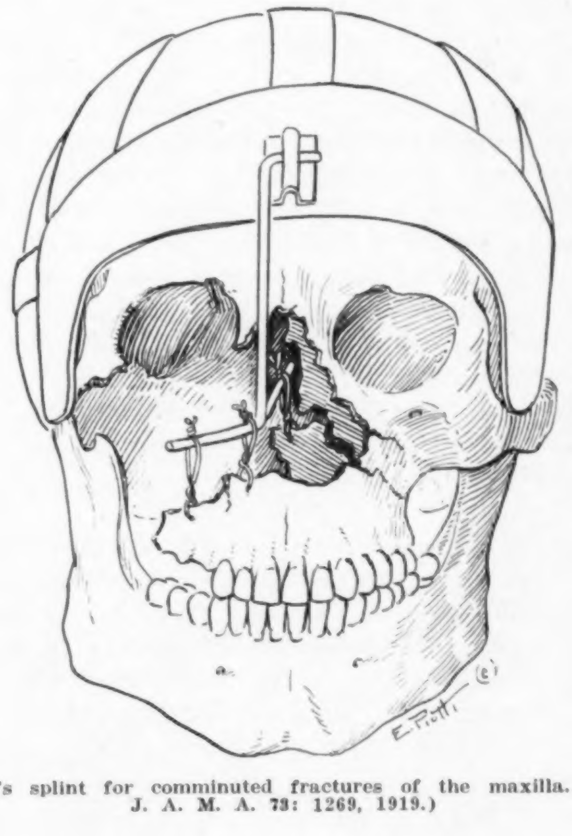


Fig. 29.—Kazanjian's splint for comminuted fractures of the maxilla. (From Kazanjian, J. A. M. A. 73: 1269, 1919.)

In the *Dental Section of the American Ambulance at Neuilly (Paris), France,* Chief Dental Surgeon Hayes and his associate, Davenport, treated a large number of difficult and interesting cases which were faithfully reported in a series of articles in the *Dental Cosmos* (1916). These are well worth studying for the description of ingenious methods used to reduce unusual fractures and treat disfiguring wounds. Le Cron (1916) described some of the splints used for treatment, which, he stated, were especially important in bone-grafting operations in which the jaws should be held rigidly together.

The Dental Department of the United States Army Hospital No. 11, Cape May, New Jersey, published a résumé of the treatment of ununited fractures of the jaws. In the article written by the Chief Dental Surgeon, McCauley, and his assistant, Worthley (1919), it was pointed out that an interdental splint should always be used in fractures of the mandible with large loss of bony substance or extensive comminution, and especially if molars are present which can be used as points of fixation. These splints were made of cast aluminum and were locked by a pin and tube device, which allowed rapid opening of the jaw in an emergency (vomiting) or for the treatment of intraoral complications, but gave solid fixation which is needed especially in bone grafts.

Hospitals for jaw injuries in Germany contributed considerably to the subject under discussion. Dolamore, in the War Supplement of the *British Dental Journal* (1916), gave a résumé of important German publications. The Germans, according to a Swiss publication, had realized that better results could be obtained in special hospitals. They established jaw hospitals in Leipzig, Berlin, Düsseldorf, Strassburg, Hanover, and Heidelberg. All the contributors to the German literature condemned wiring of the bone, and the immediate suturing of wounds likewise was not approved until a splint had been inserted. Bands and bars were applied to the teeth if the condition of the patient prevented the taking of an impression; otherwise metal cap splints, Hammond splints, and cast tin splints were used. The displaced fragments, when the fractured parts were not freely movable, were brought into place by traction with elastic bands, by pressure from a screw fastened to a divided splint, and by two metal lever arms, similar to that shown in Fig. 27. Plastic operations were extensively described but are not within the scope of this review.

BONE GRAFTING

Bone grafts were discussed in most of the important articles on the treatment of war injuries to the jaws. Among the most outstanding are papers published by the following surgeons: Morestin (1915), Horsley (1916), McWilliams (1917), Du Bouchet (1917), Cavalié (1917), Imbert and Réal (1917), Sebileau (1917), Gallie and Robertson (1918), Fry (1918), Cole (1919), Ivy (1918 and 1920), Lyons (1919), Shefford (1919), Lindemann (1916), Tainter (1919), Waldron and Risdon (1919), and Brown (1920). A superb monograph was published by Gillies (1920).

Jones (1916) set forth the following principles for the transplantation of bone:

Nutrition of the graft must be secured by perfect hemostasis because a mass of blood clot around the graft endangers its life.

Asepsis must be perfect because toxins if virulent will cause death of the bone cells in a graft.

The bed for the graft should be prepared so that rapid adhesion and organization may take place between the graft and the bone. The bone should be open at the point of contact, and the soft tissue surrounding it should be brought around the implanted part.

Perfect immobilization is a very important factor for early vascularization and union, and only when the bone is firm and beginning to ossify should function be allowed to stimulate growth and development of the graft. Function, however, should be restricted to the very mildest form of motion.

Although the principles of bone grafting were discussed earlier, and an occasional bone graft practiced in the mandible, it was not until World War I that definite procedures were established. According to Shefford (1919), Lindemann reported that he had performed 282 cases of bone grafting in his station at Düsseldorf, claiming complete success in 60 per cent, with varying degrees of improvement in the remaining 40 per cent. Cole (1919) of London quoted thirty cases of sliding grafts with complete success in 70 per cent.

Some of the views of this period on various aspects of bone grafting were as follows:

When to Use Bone Grafts.—All authors (*supra*) agreed that bone grafts should be used in cases in which bony union had failed to occur, in which a so-called pseudarthrosis existed, and in cases with great loss of substance. Ivy put down the following requirements: operation should be performed only (a) in the absence of local inflammatory or other pathologic conditions; (b) if communication with the oral cavity can be avoided; and (c) if perfect immobilization is assured by fixing the lower teeth to the upper. Shefford stated, in addition, that the best results were obtained if both fragments contained teeth to produce absolute immobilization.

Types of Bone Grafts.—The following types have been recommended:

1. Osteoperiosteal graft
2. Sliding graft or pedicle graft
3. Thick free autogenous graft

The *osteoperiosteal graft* may be used in connection with freshening of the fragments when the bone is in good position but has failed to unite. The graft is a thin layer of bone with periosteum, taken from the anterior internal surface of the tibia. According to Fry, dental splints must be worn to hold the fragments immobilized from two to two and one-half months. If not enough teeth are present, direct bone wiring is required. This method was also strongly advocated by Delaniere (1921).

The sliding graft was championed by Cole, Chief of the Maxillofacial Department of King George's Hospital, and by Tainter who worked with him and later used it in his own service at General Hospital No. 40. Together they performed more than fifty operations in which success was practically assured. Tainter used a modified detachable Gunning splint to secure immobilization of the jaw. He found the open-mouth position of value in such operations, for it facilitated feeding and eliminated muscular trismus. He stated that

liberties can be taken with a pedicled graft which would not be tolerated with a free graft. Interosseous wiring was used to unite the fragments except in edentulous jaws, in which circumferential wires were applied. The preparation of a sliding graft in the anterior part of the mandible is shown in Fig. 30.

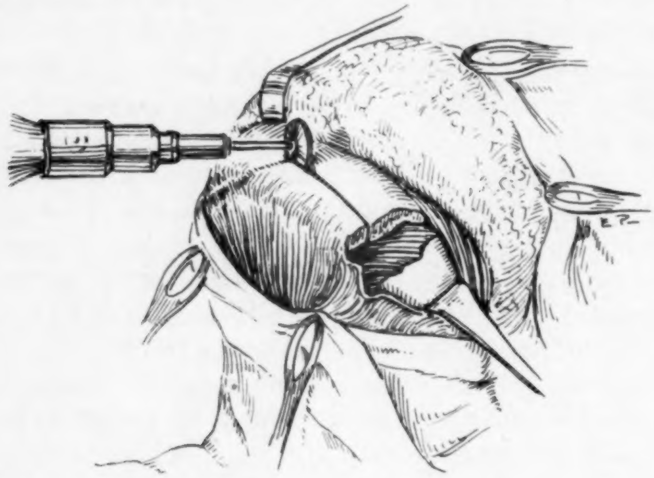


Fig. 30.—Sliding bone graft. (After Tainter, J. A. M. A. 73: 1271, 1919.)

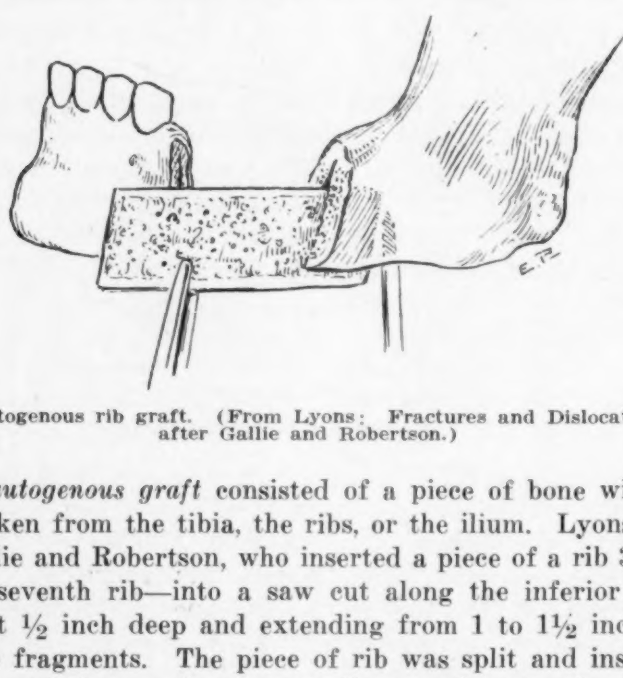


Fig. 31.—Free autogenous rib graft. (From Lyons: Fractures and Dislocations of the Jaws, after Gallie and Robertson.)

The free autogenous graft consisted of a piece of bone with periosteum. It might be taken from the tibia, the ribs, or the ilium. Lyons described the method of Gallie and Robertson, who inserted a piece of a rib 3 inches long—generally the seventh rib—into a saw cut along the inferior border of the mandible about ½ inch deep and extending from 1 to 1½ inches back from the end of the fragments. The piece of rib was split and inserted with the smooth side toward the mouth; the cancellous surface was faced outward and was sunk somewhat below the surface of the jaw (Fig. 31). The depressed bridged area was filled out with bone from the remaining part of the rib, which was placed into the gap with the smooth side facing out. Drill holes were made on each side for the use of kangaroo tendon unless the jaw could be well stabilized; in this case the graft was self-retaining and was wedged into the cuts made in the jaw by tapping.

Gillies preferred the straight block graft. If the loss included the whole of the ramus, a piece of the seventh or eighth rib including the costochondral junction was used. The bony portion was wired to the freshened anterior fragment. The costal end projected into the glenoid fossa and formed a false joint (Fig. 32). For less extensive loss of bone, Gillies believed that the main source of bone should be the ilium. Grafts from the crest of the ilium were used at Queen's Hospital at Sidcup, England (Risdon, 1922), and were also recommended by Brown who secured the graft with kangaroo tendons. The graft from the crest of the ilium, he stated, is particularly useful if a curved graft is required. Ivy preferred a piece of bone the full thickness of the crest, cut to fill exactly the gap between the fragments, and secured by means of a silver wire. He stated that this method is especially suitable if immediate rigidity is desired, if fixation by splints is not dependable, and if the loss of bone has caused a deformity.

Waldron and Risdon also preferred to form their graft from the iliac crest. They attached the graft to the jaw by means of wires, fixing it firmly into position.

Fig. 32.—Rib graft to replace ramus. (After Gillies: Plastic Surgery of the Face.)

Billington (1918) reported on the bone grafts done in association with Parrott in the Jaw Center at the First Southern General Hospital. He adopted a graft overlapping the freshened surfaces of the bone fragments, a so-called onlay graft. He remarked that tibial grafts are brittle, and while he first used a split rib, later he favored the anterior superior spine of the ilium, with the crest as far back as necessary. The detached piece of bone was often beveled and placed on its bed in such a way that the ends overlapped the gap by an inch, resting on prepared raw surfaces in the fragments. The advantages of the overlapping were the broad lines of bony contact, which eliminated the

risk of separation if the size of the gap was increased by the introduction of the dental splint, or other circumstances causing a displacement of the fragments of the jaw. Parrott (1938-1939) stated that the simple laying-in of the graft, which is left free until healed over, proved, in Billington's hands, 100 per cent successful in obtaining osseous union.

Methods of Fixation of the Mandible.—Since a great deal depended on complete immobilization, which of course is most difficult in fractures at the angle of the jaw, the cast pin and tube splint shown in Fig. 33 (Waldron and Risdon) gave the best results. For the edentulous patient, a Gunning splint with circumferential wiring has been universally recommended. The splint should be prepared and attached before the operation and locked as soon after as is safe, if general anesthesia is used.

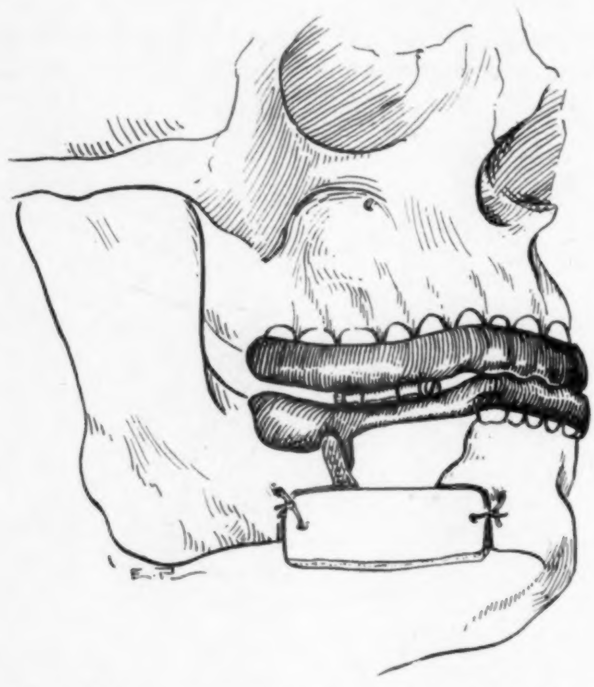


Fig. 33.—Immobilization of jaw with cast pin and tube splint for bone grafting. (After Waldron and Risdon, Proc. Roy. Soc. Med., Sect. Surg. 12: 11, 1919.)

Methods of Attaching the Graft.—The best method for fixation of the graft, Imbert stated, was that of pointing the ends of the graft and thrusting them into the fractured extremities, which dispensed with all artificial and metallic means of fixation. The Germans, especially Lindemann of the Düsseldorf Clinic, took recourse to a great deal of grafting. According to Dolamore (1916), they also cut the ends of the graft cone-shaped or wedge-shaped, and slid them into notches cut in the stump. They implanted pieces from 5 to 8 cm. long, and insisted that the essentials of success were absolute fixity, a small operating wound (only ends of the bone stumps exposed), and the imbedding of the graft in the surrounding soft tissue before the skin wound was closed.

On the other hand, Waldron and Risdon, after experimenting with pegs, steps, and dovetailing to obtain autofixation, came to the conclusion that the simpler methods were better. They did not like the peg and hole fixation because it was difficult to perform, and often destroyed the endosteal tissue which was of great osteogenic importance. They attached the graft by means of wire. Obviously Gallie and Robertson's method of grafting was the most satisfactory from the point of view of fixation of the graft because, as was stated, no means of wiring was needed in most cases, and still the contact made was good.

Postoperative Treatment.—According to Waldron and Risdon, patients should be kept in bed on a liquid diet. Iliac crest cases, they stated, should not be allowed to get up for from ten to fourteen days. In fifteen out of twenty-three bone grafts, the facial incision healed per primam. In two, slight suppuration made it necessary to remove the wires; in four cases the grafts had to be removed. The splints were kept in the mouth for two months at least. The roentgen findings governed the time of removal. Ivy, in *Annals of Surgery* (1920), gave a tabulation of 14 osteoperiosteal, 4 pedicle, and 6 iliac grafts applied to the mandible; of these, 19 were successful. Four of the failures were due to incomplete regeneration, and two failures were due to suppuration.

THE TREATMENT OF FRACTURES BETWEEN WORLD WAR I AND WORLD WAR II*

In this period new developments in locomotion contributed a great deal to the ever-increasing number of accidents involving passengers in vehicles driven by internal combustion engines, as well as to pedestrians and bystanders alike. The automobile and the airplane both contributed their share of fractured jaws. Kazanjian (1933) published a special paper devoted to "The Treatment of Automobile Injuries" and their complications.

All classes of the population were equally exposed so that these injuries, which before occurred only to drunkards who became involved in brawls and were driven in the police ambulance to the emergency ward of a hospital, became more and more numerous among private patients. The treatment of fractures, therefore, became an important part of the practice of an oral surgeon. Consequently, the result of the treatment was more carefully considered, since many cases became medicolegal ones that meant larger judgments against insurance companies if the treatment resulted in permanent disability; also the more fastidious patients themselves demanded the best obtainable cosmetic as well as functional results.

ANALYSIS OF A SERIES OF FRACTURES OF THE MANDIBLE

Several articles containing an analysis of a series of fracture cases appeared in the dental literature in this period. These related in most instances to the mandible. The series will be referred to by numerals in the tables to

*Part of this Section, including text, tables, and illustrations, appeared in *Surgery, Gynecology and Obstetrics, International Abstract of Surgery*, April, 1944, and is reprinted here by permission.

follow. One report published in 1915 will be included for the sake of completeness. They are shown in Table I.

The sex incidence was of some interest. As would be expected, there was a gradual increase in the percentage of females, which could be ascribed to the general use of the automobile and the participation of women in sports.

The age incidence was mentioned by most of the writers and was quite consistent. The largest percentage of fractures occurred between the ages of 20 and 50 years. Fractures in children under 10 years of age accounted for only 1 to 6 per cent.

TABLE I

AUTHOR	YEAR	NUMBER OF CASES
1. Dunning	1915	1,065
2. Ivy and Curtis	1926	100
3. Reiter	1928	50
4. Schmutziger	1929	179
5. Dean	1930	50
6. Woodard	1931	50
7. Winter	1934	200
8. Weisengreen and Levin	1936	60
9. Asbell	1939	115
10. Haynen	1939	669
11. Doherty	1940	100

TABLE II

ANALYSIS OF SEX INCIDENCE OF FRACTURES IN PERCENTAGES

ANALYSIS	YEAR	MALE	FEMALE
1	1915	93	7
2	1926	90	10
3	1928	92	8
4*	1929	96	4
5†	1930	100	--
6	1931	82	18
7	1934	92	7.5
8	1936	71	29
9	1939	70	30
10	1939	--	--
11	1940	88	12

*In Switzerland.
†U. S. Marine Hospital.

TABLE III

ANALYSIS OF CAUSE OF FRACTURES IN PERCENTAGES
(Computed from data contained in the various articles)

ANALYSIS	YEAR	FISTS, BLOWS	FALLS	ASSAULT	AUTO	BICYCLE	HIT BY OBJECT	SPORTS	EXTRACTION	MISCELLANEOUS
1	1915	46.5	13.0		0.2			2.1	0.5	37.7
2	1926	49.0	14.0		8.0			3.0	5.0	21.0
3	1927	54.0	3.0	37.0	10.0		2.0			
4*	1929	0.7	6.2	20.0	4.4	17.0	25.9	5.1		20.7
5†	1930	38.0	10.0	28.0			9.0			34.0
6	1931	58.0	18.0		18.0		4.0			
7	1934	62.5	11.5		3.0		7.5			
8	1936	35.0	3.3		60.0					
9	1939	25.4	17.4		30.7		13.9			
10	1939	90.0	4.0		1.0			0.5		4.5
11	1940	47.0	17.0		8.0			10.0	1.0	17.0

*In Switzerland (Swiss Accident Insurance Company, "Suval").
†U. S. Marine Hospital.

TABLE IV

ANALYSIS OF TYPE OF FRACTURES IN PERCENTAGES

ANALYSIS	YEAR	SINGLE	DOUBLE	TRIPLE	MULTIPLE
1	1915	89.0	10.0	0.5	0.1
2	1926	68.0	31.0	1.0	
3	1928	64.0	34.0		
4	1929				
5	1930	62.0	32.0	6.0	
6	1931	56.0	42.0	2.0	
7	1934	63.0	34.5	2.5	
8	1936	70.0	25.0	5.0	
9	1939	66.1	16.5	4.3	2.6
10	1939	71.3	28.7		
11	1940	66.0	31.0	2.0	1.0

TABLE V

ANALYSIS OF SITE OF FRACTURES IN PERCENTAGES
(Computed from data contained in the various articles)

ANALYSIS	YEAR	SYMPHYSIS	INCISOR REGION	CANINE REGION	PREMOLAR REGION	MOLAR REGION	ANGLE	RAMUS	CONDYLE	CORONOID
1	1915	6.5	16.5	17.0	21.25	53.75		5.0	0.8	0.2
2	1926	8.8			30.80	8.80	44.1		7.3	
3	1928									
4	1929	13.3	8.1	11.9	12.50	22.20	11.9	11.9	18.5	
5	1930	16.1			12.90	9.70	58.1		3.2	
6	1931	7.5		10.6	22.70	21.10	33.3	3.0	0.15	
7	1934	10.3	5.6	14.3	13.40	33.40	18.2	0.8	3.2	
8	1936	5.0								
9	1939	5.2		9.0	20.15	22.38	20.9	3.2	9.0	
10	1939	7.2			31.60	8.40	43.6	0.2	6.5	2.1
11	1940	15.1			30.30		48.4		3.0	3.0

Statistics regarding the cause of the fractures were of interest, especially if they were compared with the period of time in which the reported accidents occurred. The places where the injuries occurred, however, and even the locations of the hospitals where the patients were treated might be of considerable influence on the data collected for comparison.

The type of injury was classified differently in the various reports. Table IV gives an analysis of those authors who reported whether the fracture was single, double, or multiple. In many cases of double or triple fracture, the condyle was involved. Asbell reported 3 such cases, Dean 9, Ivy and Curtis 24, Woodard 12, and Haynen 28.

The degree of injury and the presence of complications are of great importance in the treatment of fractures. Among Asbell's 115 cases there were 25 compound and 14 comminuted fractures. Dean reported among his 50 cases, 1 with cellulitis, 3 with osteomyelitis, 33 with teeth in the fracture line that were removed on admission or before, and 8 with syphilis; in 4 cases the fracture extended through impacted unerupted teeth, but retention did not influence the healing disadvantageously.

The location of the fracture is of importance in the treatment. It has been thoroughly tabulated by many of the analysts (Table V).

It is evident that fractures of the coronoid process are very rare. Condylar fractures may easily be overlooked, especially in multiple fractures and when

they are asymptomatic or not demonstrated in the x-ray picture. Special x-rays should be taken routinely to show the condyles in anterior and lateral views.

IMPROVED METHODS OF TREATMENT OF MANDIBULAR FRACTURES

Some methods used before World War I were improved upon; others were simplified so that adequate fixation could be obtained by means of appliances which required a minimum of technical work and gave maximum results with less discomfort to the patient.

The following were essential requirements for the selection of a method for the treatment of jaw fractures as set forth by Winter in 1934:

1. Good immobilization of the fragments.
2. Perfect occlusion of the teeth.
3. Simplicity of application.
4. Cleanliness.
5. Comfort to the patient.

Appliances which were cemented to the teeth were difficult to take off and did not permit the removal of a sequestrum, the extraction of a tooth which might have become diseased, or irrigation of a wound. Rubber or cast splints covering the teeth were also unhygienic and prevented the observance of the occlusal contact of the teeth; also, they did not allow gradual adjustment of the fracture, which in old fractures is often the only means of bringing the fragments into proper alignment and the teeth into normal occlusion. The methods of treatment most commonly used in this period are given in Table VI.

TABLE VI

ANALYSIS OF TREATMENT METHODS IN PERCENTAGES

ANALYSIS	YEAR	INTERMAXILLARY LIGATION	EYELET METHOD	ARCH WIRES	ELASTIC TRACTION	WINTER, JELENKO ARCHES	SPLINTS			BARTON BANDAGE	CIRCUMFERENTIAL WIRING	DIRECT WIRING
							SINGLE	INTERDENTAL	KINGSLEY			
1	1915											
2	1926		79.0	10.0				6.0		2.0	1.0	
3	1928											
4	1929											
5	1930		90.0			6.0		4.0				
6	1931	42.0*	38.0									
7	1934	72.0	1.5			17.0	9.5					
8	1936		90.0	10.0								
9	1939	35.6						1.0		10.4		3.4
10	1939	52.7			30.3					3.3	13.7	
11	1940				52.0							

*Gilmer arches.

CLASSIFICATION OF MANDIBULAR FRACTURES

A classification of mandibular fractures according to their relation to existing teeth was suggested by Kazanjian in 1916. This classification has the practical advantage that it relates to treatment methods. A modification was

published by Kazanjian and Thoma in 1938. It relates to treatment and is as follows:

1. Fractures with sound teeth on either side of the fracture line.
2. Fractures with sound teeth on only one side of the fracture line.
3. Fractures of edentulous jaws, or jaws with no serviceable teeth present in either the upper or lower jaw, or both.

THE TREATMENT OF MANDIBULAR FRACTURES

Intermaxillary Ligation.—This method seems to have been given the preference in the series of fractures reported in Table VI. It was first introduced by Gilmer in 1887. Several variations have been suggested. The best known was the so-called "eyelet method" developed by Eby (1920) and Ivy (1922).

Fig. 34.—Eyelet wiring (Silverman's method).

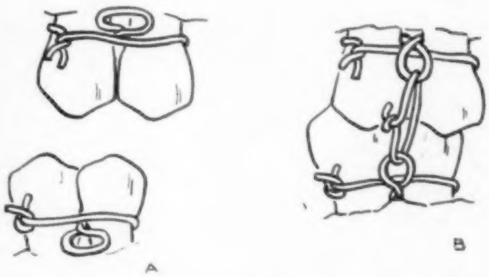


Fig. 35.—Eyelet wiring (Oliver, Eby, Ivy method).

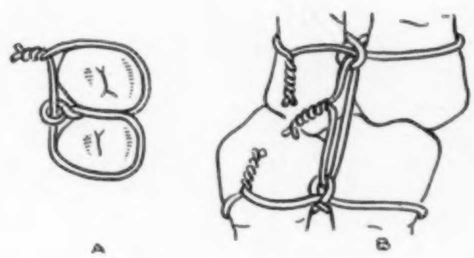


Fig. 36.—Eyelet wiring (wire passed through loop).

This was an improvement of the Oliver method described before, which was adapted by Silverman for vertical wiring, but instead of depending on a wire placed around two teeth and passed through the loop to be attached to the opposite jaw, as shown in Fig. 34, the loops were attached to the upper and lower teeth separately and secondary wires were used for intermaxillary ligation (Fig. 35). Angle's brass ligature wire, gauge 0.02, was used. This method had the advantage that if it was necessary to open the mouth, it could be accomplished by cutting only the secondary wires which were easy to replace, while the wire on the teeth remained intact. A further improvement prevented the eyelet from slipping back deep into the interdental space while the wire around the teeth was tightened; it consisted of passing one of the original wires through the loop (Fig. 36).

Risdon (1936) described a twisted type of arch wiring. The wire was placed around the right second molar and twisted on itself until a twisted

cable extended as far as the central incisor. The same procedure was repeated on the left side, after which the two cables were twisted together in the median line. Thus, a fairly firm arch was made for either the upper or lower jaw. Individual teeth were then wired to this arch, and interdental splinting could be accomplished by connecting the two cables with secondary wires.

Dental Splints.—New types of splints have been devised with the point in view of overcoming some of the inherent disadvantages of a dental splint. Splints attached to the teeth were efficient because of the greater strength and security which they gave to the fractured jaw. If sufficient teeth were present, patients might even be allowed to eat soft food if the fracture was a simple one. Such splints made of vulcanite or cast silver, in one or two pieces with a hinge and locking device, were still favored by Risk in 1941. Willet (1928) described a cast splint made up of a row of overlays which did not irritate the gingival margin and interdental tissues. Morgan (1934) described an improved splint for fractures of the upper jaw. It was made of a Gilmer arch bar, to which were soldered the Marshall tubes for insertion of the Kingsley wings (Fig. 37). To Morgan's splint, however, were added palatal bars and occlusal rests which gave greater rigidity and more stability. Such splints were hygienic and allowed closed observation of the occlusion. A similar splint, cast in its entirety except for the tubes which were soldered to each side, was described by Thoma (1942).

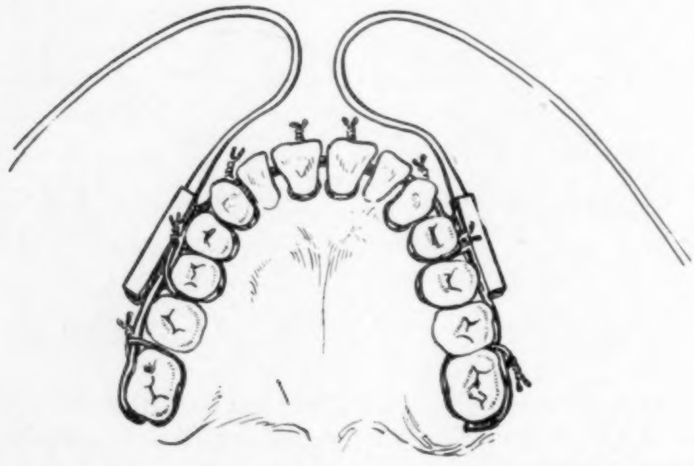


Fig. 37.—Upper arch wire with Marshall tubes and Kingsley wings. (After Thoma: Traumatic Surgery of the Jaws.)

Splints were also useful in fractures of edentulous jaws. The Gunning splint has remained in use, and it was recommended that splints be improvised by wiring together the two dentures, if the patient wore them; they could then be placed in the mouth and the jaws held in position with a bandage. Bandages with elastic traction were recommended by Gingrass (1938), Dingman (1939), and A. H. Miller (1941). The latter used a skull cap or surgeon's cap with a rubber dam fastened to the cap with safety pins. Kazanjian (1933) recommended a Barton bandage reinforced by elastics attached at each side of the face with adhesive strips. Mead (1934) advised the use of the plaster head cap of Scogin (1928) with a rubber dam strapped on around the chin.

Circumferential Wiring.—A great improvement in the use of splints for fractures of edentulous mandibles resulted from the introduction of circumferential wiring, as first advocated by G. V. Black and described by Ivy (1922), Goodsell (1930), Bender (1936), Addison (1938), Jones (1939), Parker (1939), Thoma (1942), and Doherty (1943). The instrument used to introduce the wire varies; some like the cannula of a trocar, others use an eyeleted trocar, a ligature carrier, or a curved hypodermic needle (Fig. 64). For wire, 16 gauge silver wire was first used, but 22 gauge stainless steel has today replaced the former. It is fastened over the patient's artificial denture or a vulcanite or metal splint which is made to fit the alveolar ridge.

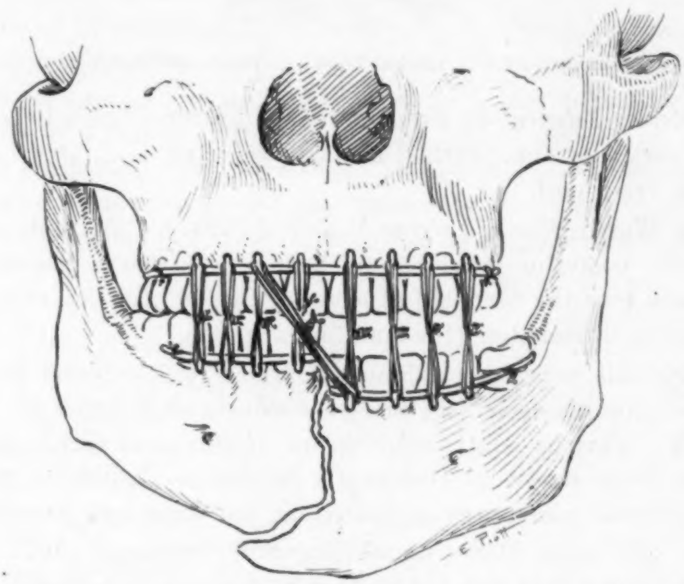


Fig. 38.—Reduction of mandibular fracture by elastic traction. (After Ivy and Curtis.)

Elastic Traction.—The gradual reduction of fractures by intraoral and intramaxillary traction was first described by Darnall in 1923. It was used in cases in which immediate reduction was not possible either because of fragments held in a displaced position by muscle spasm, or because the fracture had consolidated to a greater or lesser extent as the result of delayed treatment. The appliance used for intermaxillary traction was a modified Gilmer arch applied to both the upper and lower teeth. Lugs soldered to the bar pointed up or down respectively, and served to attach small elastic bands (Fig. 38). Darnall pointed out that an additional advantage of using elastics in the Navy lay in the fact that they were easily removed, or if reduced in number, the patient could force his jaws apart by grasping the chin and pulling it down in case of sea sickness. This also applied to all wounded men transported by ship or plane. Moorehead (1934) stated that he used elastic traction in practically all cases in which reduction was required, and that the mechanism employed served equally well for immobilization. Winter (1934) introduced a prepared splint which could be easily shaped to conform to the outline of the dental arch, to which it was attached by fine wires passed around most of the teeth. Round lugs served for the attachment of elastic

bands. Kazanjian described a simplified method of affixing rubber bands. He formed buttons from wires passed around two adjoining teeth; these wires were twisted until they were wound into a knot (Fig. 39). The method was described in Kazanjian and Thoma's chapter on "Fractures of the Facial Bones" in Scudder's *The Treatment of Fractures* (page 370).

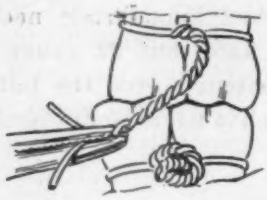


Fig. 39.—Kazanjian buttons. (After Thoma: Traumatic Surgery of the Jaws.)

The Posterior Edentulous Fragment.—In fractures behind the dental arch, which were very common, marked upward, forward, and lateral displacement of the ramus was found.

"During World War I," wrote Waldron (1942), "attempts were made to hold down the posterior fragment by means of a screw passed beneath the zygomatic arch into the coronoid process, or by the insertion of a nail beneath the zygomatic arch and above the mandibular notch."

Following this, other methods were devised to counteract the muscle pull which caused this displacement, and to reduce and stabilize the fragment of the mandible. Various controls by means of intraoral splints have been devised. They were shown in Dorrance's Historical Exhibit of the Treatment of Jaw Fractures, which was presented at the American Dental Association meetings in 1937 and 1938. Lenormant and Darcissac (1927) described a method of drilling a hole into the posterior fragment on both sides at the angle of the jaw, and passing a wire through the skin. The ends of the wire were connected by rubber elastics across the back of the neck. Ivy and Curtis (1931) suggested the attachment of the wire by means of elastics to a hook in a plaster cap. The procedure of Ivy was recommended by Doherty (1937) and Dingman (1939). Dorrance stretched a wire from an intermaxillary metal splint, from which a bar extended out of the mouth to the angle of the jaw, hugging closely the surface of the face. Here the wire was attached to a vitallium pin inserted into the angle of the jaw through the skin. Gross (1943) described a similar appliance. MacGregor (1940) used an apparatus attached to a plaster cap from which an arm descended, holding a swivel rod. This rod held the wire which was inserted into the angle of the jaw. The appliance allowed more accurate adjustment than those described heretofore. Blair (1923) constructed an appliance for intraoral support of the ramus in the form of a splint with a jackscrew and silver points engaging the lower part of the postmolar triangle. Thoma (1926) described a screw extension from a maxillary splint that could be regulated, while Kazanjian (1933) preferred a splint attached to three posterior mandibular teeth, which had a 16 gauge wire extending to the ramus with one or two prongs which prevented upward dis-

placement of the posterior fragment. This simple arrangement is shown in Fig. 40. Waldron mentioned the use of a grooved splint extension, and Aufderheide (1934) described a lug.

Open Reduction.—Direct wiring has generally been condemned by writers of this period. Ivy (1922) stated that direct osseous wiring and the use of bone plates caused osteomyelitis and sequestrum formation, because most fractures were compounded into the mouth; furthermore, he added that they gave insufficient stability. Berger (1927) agreed that both fixation by means of silver or bronze wires applied through drill holes, and the use of metallic plates (Lane plates) attached to the bone across the fractures not only have invariably failed to secure union, but also have caused necrosis and loss of considerable bone. Waldron (1942) wrote that direct surgical wiring has been so frequently followed by postoperative infection, necrosis, sequestration, and nonunion, that this method has been largely abandoned. Kazanjian (1933), in contrast to the others, reported success with intraoral osseous sutures, which, he stated, were much simpler to apply than sutures requiring an external incision. He let the wires protrude through the mucous membrane for drainage.

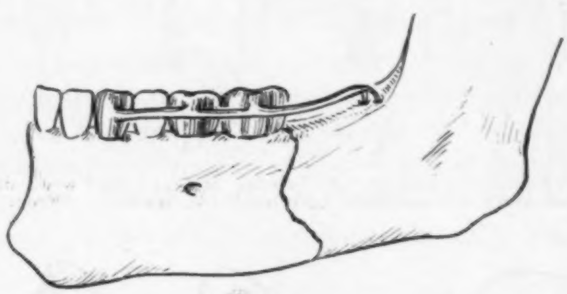


Fig. 40.—Splint with extension wire to control ramus. (After Kazanjian, J. A. D. A. 20: 757, 1933.)

Bone Grafts.—We have seen that methods of bone grafting were developed during World War I in response to the need for a satisfactory way of securing union in difficult cases, and replacing lost osseous structure. Ivy and Epes (1927) pointed out that in civil practice bone grafting had many applications in cases of nonunion and loss of bone from osteomyelitis, and resection for neoplasm. They also stated that they did not like the pedicle graft, because it caused undue distortion of the soft tissues of the mouth and neck. They considered that the tibia was unsuitable because of the extreme density and consequent resistance to penetration of new blood vessels in the process of consolidation. Therefore, they limited themselves to the use of osteoperiosteal grafts and block grafts from the ilium; the latter are described by Ivy and Curtis (1928). Albee and Seldin (1934) described the removal of a slab of bone at the angle of the jaw in the case of an ununited fracture, in order to make a diagonal straight cut. This slab was left attached to the soft parts. A tibial graft was laid against the freshly cut mandible, and after placing the jaw slabs against this, the grafts were held in place by the kangaroo tendon previously inserted into holes drilled into the two fragments of the bone.

FRACTURES OF THE CONDYLE

Since the beginning of World War I and the development of x-ray examination, condylar fractures were diagnosed not only more accurately, but also more frequently, because this fracture when occurring with other injuries was formerly often overlooked. Rüedi (1928) and Dufourmental (1929) made the first comprehensive studies of condylar fractures.

Complications.—Thoma (1938) classified complications as follows:

1. Overriding of fragments.
2. Forward, medial, lateral, and backward displacement of the condylar fragment.
3. Forward, medial, and lateral dislocation of the condyle.

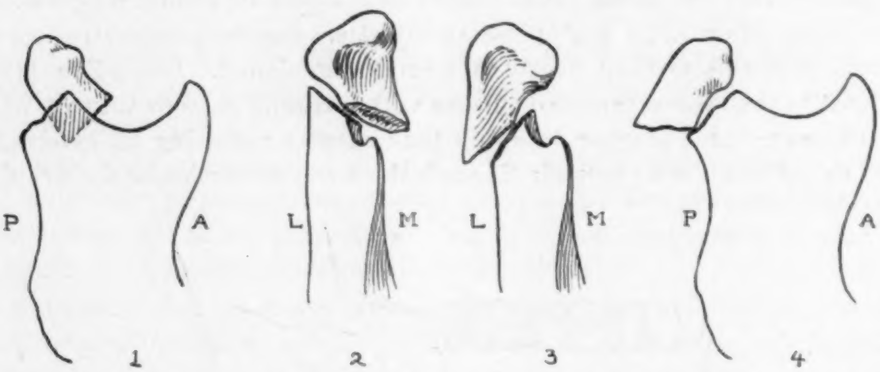


Fig. 41.—(*1*) Forward, (*2*) medial, (*3*) lateral, and (*4*) backward displacement of neck of the condyle. *P*, Posterior; *A*, anterior; *L*, lateral; *M*, medial. (From Thoma: Traumatic Surgery of the Jaws.)

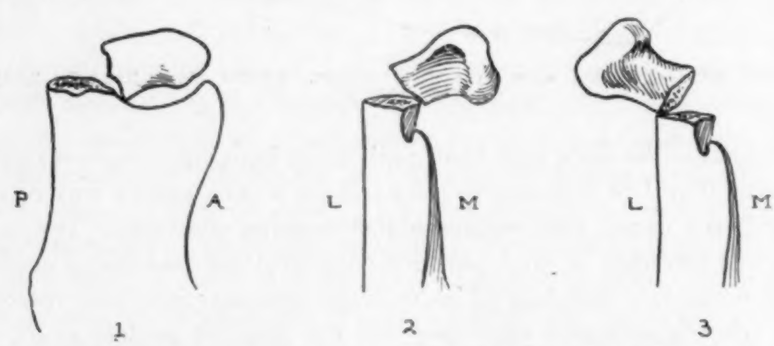


Fig. 42.—(*1*) Forward, (*2*) medial, and (*3*) lateral dislocation of the condyle. *P*, Posterior; *A*, anterior; *M*, medial; *L*, lateral. (From Thoma: Traumatic Surgery of the Jaws.)

Of these complications, overriding of the fragments is seen in almost all fractures through the neck of the condyle since most of the fractures are of the extracapsular type, occurring in the subcondylar area. Forward displacement is common because of the attachment of the external pterygoid to the condylar fragment. Medial, lateral, and backward displacements are due to displacement by the overriding mandibular fragment (Fig. 41). Dislocation is fairly common because of the free movement of the condyle within the capsule, so that the force of the trauma may push it out of the glenoid cavity (Fig. 42). Bellinger, Henny, and Peterson (1943), in an analysis of 100 cases, found overriding with no displacement in 16 per cent, displacement in 57 per

cent, a dislocated condyle in 25 per cent, and fracture involving the joint surface (intracapsular) in 2 per cent of the cases. These complications are disclosed by means of roentgen films taken from different angles; a lateral view and an anteroposterior exposure will generally be sufficient for a correct diagnosis. The lateral view should be without interference of the spinal column, with a clear view of the ramus and condyle.

Walker (1942) described gunshot injuries of the condyle. These might be so extensive that it would be difficult to classify them except as separate entities. Generally they caused comminution of the upper part of the ramus including the coronoid process, or comminution of the condyle itself. The damage might be intracapsular, and often it involved the glenoid cavity. Such injuries were generally fatal because of the vital structures involved. If the injured person survived, ankylosis developed either because of the injury itself, or because of secondary infection which set in.

Examination.—Walker (1942) stated that symptoms were absent in some cases, while in others swelling and discoloration appeared over the area; pain and tenderness were increased by movement; there was inability to masticate because of open-bite; and incorrect occlusion, crepitus, and abnormal mobility were found. Examination would reveal swelling, inability to incise, trismus (marked or absent), and injury on the chin or side of the face. In unilateral fractures the chin deviated to the injured side when the mouth was opened; in bilateral fractures forward excursion of the jaw was impossible. Often there was hemorrhage from the ear, which indicated injury to the auditory canal. Palpation with the fingers in the auditory canal might disclose the abnormality. Round (1939) recommended the use of a stethescope to detect crepitus.

Treatment.—In treating condylar fractures, the main effort of most of those who wrote on this subject in the past has been directed toward the attainment of normal occlusion of the teeth. Very little has been done to correct displacement and dislocation of the condyle. The following methods have been advocated:

Immobilization by intermaxillary ligation, i.e., conservative treatment, has been advocated by Cole and Bubb (1916), Boon (1926), Aufderheide (1934), Ivy and Curtis (1928), James (1940), Mead (1940), Winter (1943), and Berger (1943). Bonney (1927) used intermaxillary wiring in a case associated with open-bite, tightening the wires every day until normal occlusion was obtained. The time of healing was believed by most writers to be five weeks. Cole and Bubb (1916) used splints to keep the mouth in open-bite position, and Russell (1930) also recommended this treatment. Walker, however, pointed out the correct fact that this tended to result in union in malocclusion. Waldron (1942) believed that intermaxillary ligation gave satisfactory results even when the condylar fracture was associated with dislocation. Steinhardt (1936), who also recommended conservative treatment for dislocated fractures, believed that as a result of function the dislocated condyle would be rebuilt and form a new, well-functioning joint. Fry (1929) and others believed in fixation for two to three weeks only, to be followed by active movement. Dufourmental

(1929) recommended the use of arch wires and elastic traction to control the movement. Walker, on the other hand, stated that active movement or movement controlled by elastics led to the formation of a false joint. Thoma (1943) agreed with him, and presented a patient 18 years old, who had fractured his jaw at the age of 9 years. Inadequate treatment led to pseudoarthrosis with pain and limited motion (Fig. 43).

The treatment of fractures of the condyle in children by the conservative wiring method, with successful results, has been reported by Brown and Hamm (1932) and Thoma (1938); Krohn (1934) has recommended the use of intraoral splints with extraoral extension for the application of rubber band traction from a plaster of Paris cap applied to the head in order to correct open-bite.

Fig. 43.—Pseudoarthrosis in patient 19 years old, who sustained a condylar fracture when 9 years of age. (From Thoma: Am. J. Orthodontics and Oral Surg. [Oral Surg. Section] 29: 551, 1943.)

Functional Treatment.—To allow active movement of the jaw was advocated by Zemsky (1926), Guy (1928), and Steadman (1939), all of whom felt that immobilization was unnecessary, inadvisable, and often resulted in incomplete function. Walker rightly pointed out that inadequate fixation or early movement frequently resulted in nonunion. The above case reported by Thoma (1943) in which pseudoarthrosis resulted, with limited and painful motion, is proof of that. Kazanjian and Strock (1942) concluded as follows: "Much harm can be done by failing to recognize the fact that condyle fractures do well if no radical procedures are attempted and the operator contents himself with simple immobilization."

Opinions Obtained on the Results of Methods Described.—While the opinion has been almost universally expressed that condylar fractures take care of

themselves if intermaxillary ligation is applied, careful checking of the ultimate results did not give so good a picture. Campbell (1942) reported restricted motion of the mandible following such fractures. Risdon (1934) reported ankylosis in 5 per cent of the treated cases; Federspiel (1939) stated that he never had a case of dislocated and fractured condyle in which limitation of motion was avoided. Gruber and Lyford (1942) checked on ten patients treated between 1925 and 1941 by intermaxillary fixation for six weeks, and found that five had minimal loss of function; three had appreciable loss of function, malocclusion, and deviation of the mandible; and two suffered ankylosis requiring arthroplastic procedures.

The realization through careful checking that the results of treatment with intermaxillary ligation were not as good as reports of individual cases led one to believe had stimulated attempts to improve the technique both of reduction and of fixation of fractures of the condyle. Since there was no doubt that more than average skill and experience were needed to practice open reductions, almost everyone has been trying to develop a conservative method that would give satisfactory results in the hands of the average practitioner.

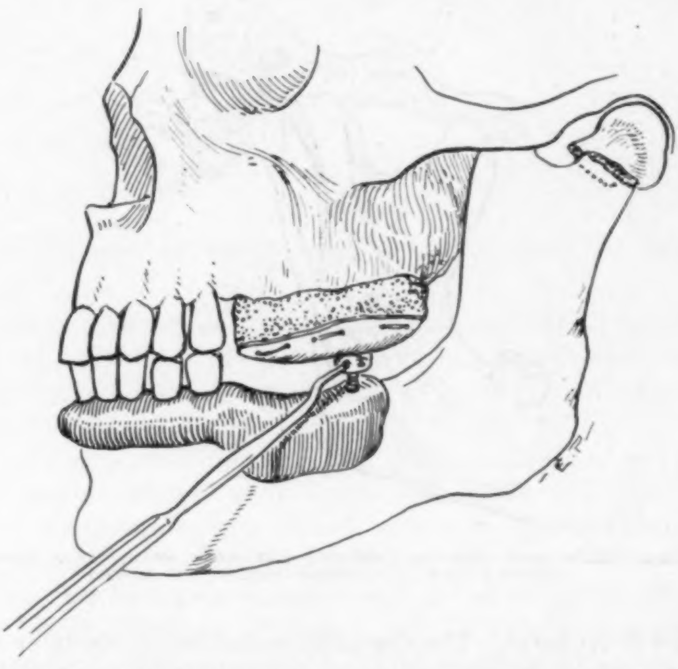


Fig. 44.—Appliance to reduce condylar fracture in partly edentulous jaws. (After Gruber and Lyford, Am. J. Orthodontics and Oral Surg. [Oral Surg. Section] 29: 161, 1943.)

Reduction Through Leverage and Traction.—In order to correct shortening of the ramus caused by overriding, Ivy and Curtis (1931) suggested interposing a base plate gutta-percha between the molar teeth before fastening the teeth in occlusion. Waldron (1942) placed a split piece of rubber tubing between the upper and lower molars; while Gruber and Lyford (1942) inserted increasingly larger wooden wedges between the posterior teeth to overcome

the muscle spasm which caused the overriding. In case of edentulous jaws these procedures could not be applied; instead Gruber and Lyford (1943) advocated an appliance shown in Fig. 44, which made it possible to increase the distance between edentulous posterior sections of the jaws by turning a jackscrew which in turn brought down the mandibular fragment. This appliance could be modified for use when one of the jaws contained teeth. It might also be of value in maintaining or increasing vertical dimension after osteoarthrotomy for ankylosis. Thoma (1942) stated that he has used elastic traction with bite blocks for some time; Jelenko splints were attached to the upper and lower jaws and traction was applied in the anterior part of the mouth in order to get as long a lever action as possible (Fig. 71). This method has universally resulted in good occlusion, but has not corrected the overriding at the neck of the condyle. Experimental use of thicker bite blocks or stronger external traction from the chin to a head cap did not bring better results. The failure was due to the accessory mandibular ligaments which limited the distance the mandible could be pulled down against the elevator muscles of the jaw (Fig. 45).

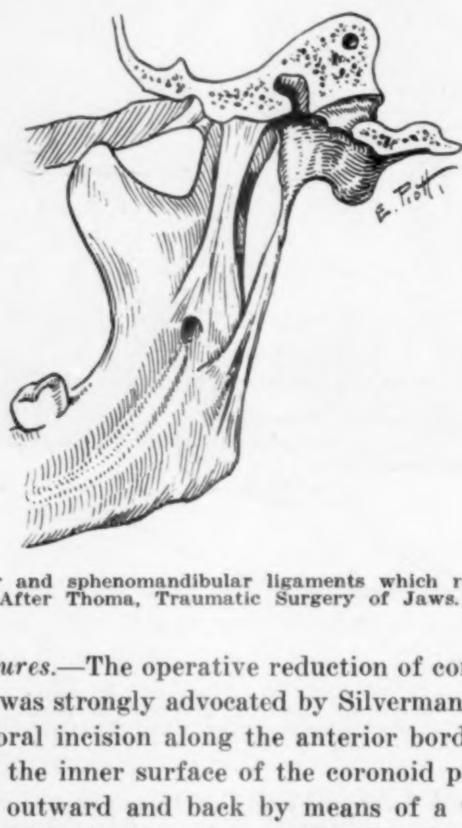


Fig. 45.—Stylomandibular and sphenomandibular ligaments which resist downpull of ramus. (After Thoma, Traumatic Surgery of Jaws.)

Operative Procedures.—The operative reduction of condylar fractures with marked displacement was strongly advocated by Silverman (1925). His method consisted in an intraoral incision along the anterior border of the ramus, and after the tissue from the inner surface of the coronoid process was lifted, the condyle was pressed outward and back by means of a urethral sound while the condylar area was felt for from the outside (Fig. 46). When contact was established, the wires, which had been previously attached to the teeth, were twisted together to effect intermaxillary fixation. (This method appeared to have possibilities, although no one has since reported using it. I have tried it to reduce a medially dislocated fractured condyle, but I found it was im-

possible to push the head of the condyle back into the glenoid fossa, probably due to resistance caused by the capsule that had collapsed. Also, working in a deep wound, guided merely by the sense of touch, was not as easy as it appeared to be from an illustration of the operation.)

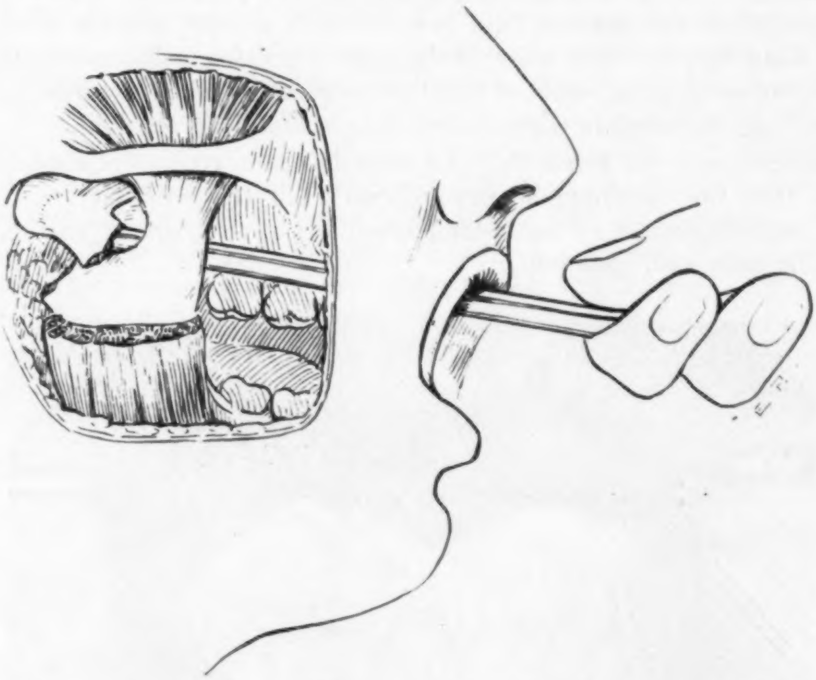


Fig. 46.—Silverman's method of reducing displaced condylar fractures. (Silverman, Dental Cosmos 67: 876, 1925.)

Thoma (1938) has reported success in pulling back a medially displaced condyle with a sharp hook through an incision made in front of the ear, as used for arthroplasties, while the ramus was pulled down by an assistant. After twenty-three days of intermaxillary fixation, the fracture had healed, and five days later normal function had been regained. Aison (1926) advocated direct osseous wiring, and Wassmund (1934) and Steinhardt (1936) recommended that this procedure should be used for displaced condyles if there was no hope for union. The latter reported a case of double condylar fracture with dislocation in which a good anatomical as well as a good functional result was obtained by direct wiring. Thoma (1942) has used direct wiring of badly displaced condyles by a method described in *Traumatic Surgery of the Jaws.* The wire was pushed through the outer cortex only, and not completely through the bone. Waldron (1942), on the other hand, reported two unsuccessful attempts at open reduction, and ended by removing the dislocated fractured head; this gave a good result. Dingman (1939) condemned all methods of open reduction, having seen several cases of ankylosis follow "meddlesome surgical measures."

Strömberg (1934) was the main representative of the most radical school. He recommended condylectomy, because of experience with other joints in

which luxated fragments produced arthritis deformans unless reset or extirpated. Bellinger (1941) reported sequestration of the condyle in a case of head injury with swelling and abscess formation in the right cheek. Berger (1943) also favored complete removal of the condylar fragments if they cannot be brought into a satisfactory position by manipulation. Walker, on the other hand, took the position that patients with a condylectomy might have occlusal disturbances which were likely to be a greater disadvantage than the changes occurring as a result of fracture dislocation. He recommended condylectomy only for cases in which severe pain or ankylosis resulted.

Stabilization of the Mandible.—All methods described, except condylectomy, required that the mandible be immobilized until the condylar fracture has healed. Stabilization may be accomplished by intermaxillary wiring, or by traction in cases with open-bite.

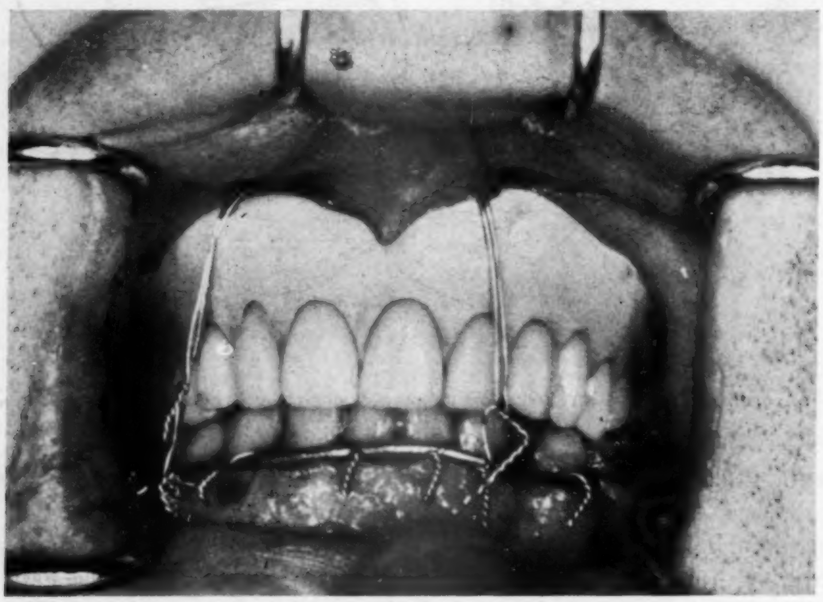


Fig. 47.—Method of immobilizing mandible by internal wiring. (From Thoma, Am. J. Orthodontics and Oral Surg. [Oral Surg. Section] 29: 437, 1943.)

Difficulties occurred when the mandible or maxilla were edentulous. The immobilization in such cases might be accomplished by splints, although these are not always effective. Waldron (1942) described a case of bilateral fracture of the neck of the condyle in an edentulous patient. The mandible was displaced backward more than ¾ inch, and although the repaired dentures were used as splints, repeated attempts to bring the mandible forward were unsuccessful until a Kirschner wire was drilled through the symphysis, by which, after forcible reduction, the mandible was held in position by means of forward and upward rubber band traction applied from an unusual head appliance and U-shaped wire. Thoma (1943) used internal wiring from the nasal aperture over a maxillary denture to an arch supplied to the lower teeth (Fig. 47).

No doubt there is an opportunity for developing still better methods of reduction and fixation of condylar fractures, which seem to have become more common during the last decade or two.

FRACTURES OF THE MANDIBULAR RAMUS

Fractures of the mandibular ramus are comparatively uncommon. Very little has been written about them. The best paper on this type of injury is that of Walker (1942). The fracture generally descends from the mandibular notch. We may distinguish: (1) oblique fractures extending in a posterior and downward direction (Fig. 48, *1*), the most common; (2) fractures in a forward direction which are the so-called fractures of the coronoid process (Fig. 48, *2*); (3) vertical fractures (Fig. 48, *3*); and (4) horizontal fractures (Fig. 48, *4*). Vertical and horizontal fractures are rare. Fractures of the ramus have been reported by Colyer (1917), Blair (1918), Mead (1927), Crawford and Watt (1933), Walker (1942), and Thoma (1942). Comminuted fractures are generally caused by shrapnel, bullets, and bomb splinters which produce penetrating or glancing wounds; these were particularly well described by Walker.

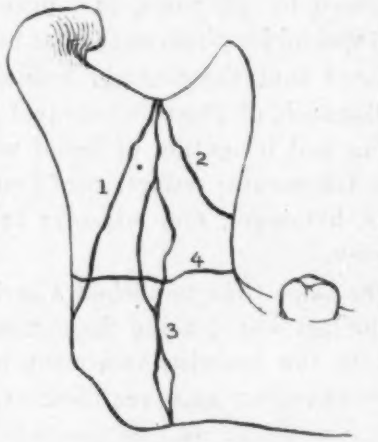


Fig. 48.—Fracture lines that may occur in the ramus.

Treatment.—Walker stated that, in the treatment of posterior oblique fractures, the mandible should be fixed for about five weeks in a closed position. He treated anterior oblique or coronoid fractures the same way to prevent fibrous union or nonunion, because he found that displacement caused by trismus of the injured temporal muscle disappears rapidly with immobilization. He stated that transverse and vertical fractures unite with no resulting deformity even if displacement was severe, which contraindicates wiring by open operation as recommended by Coughlin (1920). The prognosis of gunshot fractures, in Walker's opinion, was very good. Dental complications were absent, and generally the fractures were not compounded into the mouth. He stated that débridement should be done with great care, and bone that might be a decisive element in the union of the fragments must not be removed. Drainage should be established if there were any signs of infection.

THE TREATMENT OF FRACTURES DURING WORLD WAR II

Ivy (1943) wrote: "While the principles of treatment of fractures of the jaws were well understood thirty years ago, and fixation by apparatus applied to the teeth resulted in successful restoration of occlusion, there have gradually been developed simplified methods of fixation which require less technical work and which assure more rapid results with greater comfort to the patient." Ivy referred to skeletal fixation as "a valuable adjunct when the time-honored methods are not applicable."

Skeletal fixation which requires the use of an external appliance, and internal wiring fixation with the wires concealed were developed in the period under discussion. Another innovation was the discovery of the sulfonamides, chemotherapy being applied both to prevent and to control infections associated with compound fractures and war wounds of various types.

WAR WOUNDS

Soon after the outbreak of the war, Fry (1939) published an article in which he stressed the importance of preparation of the profession to give first aid to jaw injuries caused by air raids, and urged that patients with such injuries be passed on to special hospitals as soon as possible.

Parrott (1938) stated that the first-aid treatment should consist of the following measures: diagnosis of fracture; control of hemorrhage and danger of suffocation; cleansing and irrigation of facial wounds; removal of foreign bodies, roots, and bone fragments; reduction of fractures and temporary fixation by wiring, splints, bandages, and adhesive tape; and suture of wounds and flaps in an emergency.

James (1939) at the same time published a series of articles based on the experience gained in the last war, tracing the course of jaw injuries from first aid on the battlefield to the complex treatment at a maxillofacial hospital. He pointed out that the character and treatment of face wounds differed from other wounds, as the cosmetic as well as the functional result must be considered. The bone lesions differed from the civilian type. They were almost always compound and infected, and generally comminuted. Complications were malposition, malunion, and nonunion. He described methods of skin and bone grafting, and various mechanical appliances to be used as supportive treatment. He designed an instrument (Fig. 49) to hold the mandible or the largest fragment forward, if general anesthesia was employed, which should be useful to the surgeon.

World War II brought with it injuries both to the civilian population and to the men serving in the Armed Forces. A report dealing with 119 cases of jaw fractures treated in an E. M. S. (Emergency Medical Service) Maxillofacial Unit between Sept. 3. 1939 and Dec 31, 1940 was contained in an article by McIndoe (1941). Half of these cases had other injuries and most of them were due to extreme violence. Bomb and mine explosions and penetrating missiles accounted for 45 per cent; collisions of high-speed vehicles such as motor cars and airplanes for 36 per cent, and collapse of buildings for 13 per cent. Interdental wiring and cast metal cap splints with pin lock were used

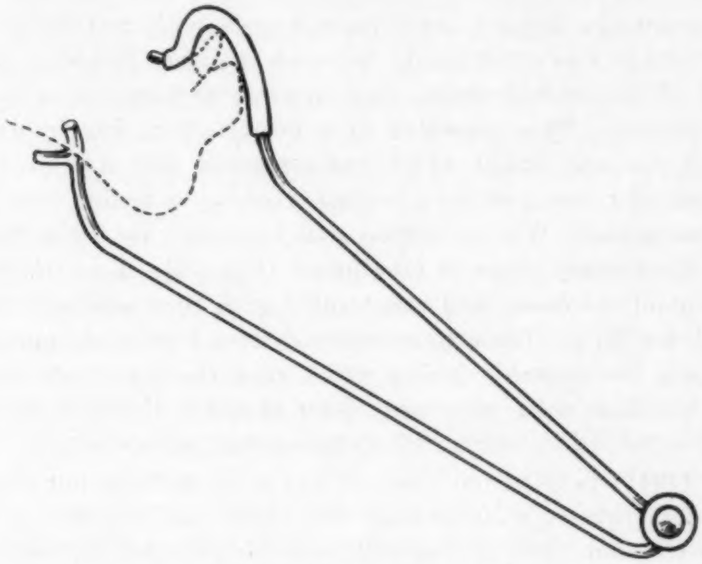


Fig. 49.—Instrument to hold fractured mandible under anesthesia. (After James, Brit. D. J. 67: 483, 1939.)

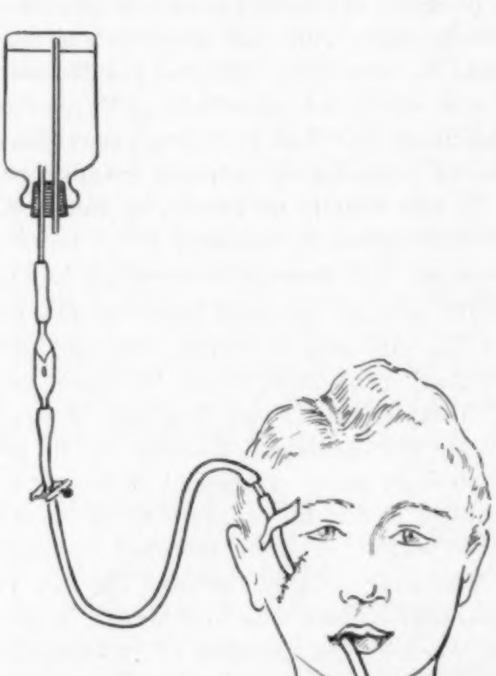


Fig. 50.—Irrigation with Dakin's solution. (After Shepherd, Brit. D. J. 69: 431, 1940.)

for fixation; suturing twenty-four hours after the accident was found inadvisable; the wounds, instead, were packed open with petrolatum gauze, and adequate drainage was established. To control sepsis, McIndoe recommended the removal of the teeth from the fracture line and irrigation by Shepherd's (1940) saline drip. This consisted of a bottle containing hypertonic saline solution (1.5 per cent NaCl) which was connected with a drain tube inserted into the wound by means of a rubber tube holding a visible drip regulated to 120 drops per minute. The irrigation was controlled by the patient and used for half an hour every three to four hours (Fig. 50). Loss of bone occurred in 12 per cent of the cases, and was treated with bone grafts if the space was more than 1 cm. long. These were inserted from four to six months after the signs of sepsis disappeared, during which time the fragments were splinted. Bone from the iliac crest was used; after shaping, this was wired correctly between the exposed fragments with stainless steel ligatures.

Brown (1941) pointed out that, in war wounds from bursting shells and hand grenades, fragments of clothing, dirt, metal, and the like might be found. Fish (1941) felt that, as most fractures were compounded into the septic buccal cavity, bone wounds containing foreign bodies or detached fragments of bone, pieces of dead muscle, and particularly a detached tooth in the fracture line, provided a medium in which organisms grew and proliferated indefinitely. He agreed with Colyer's excellent rule that any tooth in the line of a septic compound fracture should be extracted. He also pointed out that early immobilization of fractures was almost as important as the antiseptic treatment. Kazanjian (1941), in addition, felt that even small particles of dirt and especially powder, if not removed immediately, became encapsulated leaving permanent marks in the skin. It was usually necessary, he stated, to give a general anesthetic for the vigorous mechanical cleansing which required the use of a brush, or a sharp knife to scrape out these particles when lodged more deeply.

MacGregor (1941) pointed out that sepsis in the jaws, as elsewhere, depended not only on the infecting organism, but also on the resistance of the patient. He stated that, in an analysis of 100 cases treated at the Hill End Hospital and R.A.F. Hospital in Halton, England, it was found that in the age group of 20 to 29 years the incidence of sepsis was 30 per cent. It rose until, in the age group of 50 to 59 years, it reached 70 per cent. The infection might be due to the presence of foci of infection, or might be introduced by a foreign body, through a tooth socket, or along lymphatic channels at the time of the fracture, or later. The analysis also disclosed the fact that while the average time for union in nonseptic cases was four weeks, in septic cases it increased to seven and a half weeks. The question of external drainage was discussed by Rushton (1942). He stated that at the Plastic and Jaw Injury Center E.M.S., Basingstoke, England, many cases were seen in which drainage was urgently required and had not been provided. He summed up his article by enumerating instances of compound mandibular fractures in which external drainage was advocated:

1. In all cases in which there is an external communicating wound.

2. In all cases in which the fracture hematoma has been destroyed and infected, even though no pus can be seen nor is suspected.

3. In cases with a very large hematoma beneath the fracture.
4. In all cases in which there is a collection of pus, or a sequestrum at the lower part of the fracture line.
5. In certain late cases in which there is progressive bone loss.

Chemotherapy.—As early as 1939 the British Royal Army Medical Corps recognized the value of the prophylactic use of chemotherapy. In this country, Ivy (1941), a member of the Committee on Surgery of the National Research Council and of the subcommittee on Plastic and Maxillofacial Surgery, enumerated the objectives and principles of management of injuries of the face and jaws, and pointed out that one of the first considerations in the treatment of wounded soldiers was the combating of infection. Wounds should be carefully revised, foreign bodies removed, abscesses opened, and drainage established. Local and general chemotherapy should be employed when indicated by cultures. In a lecture given at the Institute of War Medicine and Surgery for Dentists in Chicago in 1942, Thoma (1943) also called attention to the great advances in the treatment of infected wounds made by the oral administration and local application of one of the sulfonamide drugs, and also pointed out the danger of Vincent's infection in fractures compounded into the mouth. Mitchell, Logie, and Handley (1941), in describing their experiences in treating war casualties in a base hospital in Libya, recommended the local use of sulfanilamide together with 1.5 Gm. by mouth given three times a day for six days, as a prophylactic measure, and larger doses in cases in which the wounds were already infected. Campbell and Smith (1941) who referred to compound fractures of various bones in civilian practice, stated that chemotherapy has reduced the incidence of infection by 10 per cent, and that in conjunction with sulfonamide drugs, internal fixation was well tolerated. In a work edited by Bailey (1941) and written by sixty-five contributors, apparently before sulfathiazole and sulfadiazine were introduced, oral administration of sulfanilamide was recommended for streptococcic, and sulfapyridine for staphylococcic, infections of war wounds. Heggie, et al. (1942), on the other hand, discussed four cases of compound fractures caused by bomb splinters infected by *Staphylococcus aureus,* and found sulfathiazole more satisfactory than sulfapyridine; they recommended its oral and local use at the time surgical procedures were undertaken.

Haddock (1942) of the Dental Corps, U.S.A., in a small series of cases (eighteen) of mandibular fractures, found a marked reduction in the percentage of infection in the cases receiving sulfathiazole therapy as compared with the percentage in a control group (fifteen cases) receiving no chemotherapy. The treatment consisted in the oral administration of sulfathiazole (4 Gm. on admission and 1 Gm. four times a day), as well as daily implantation if there was sufficient access to the fracture.

Amies (1942) stated that in the Middle East and the desert, where the problem of the hemolytic streptococcus was acute, sulfanilamide was prescribed in all jaw cases in which infective complications became apparent.

Grunewald (1943) stated in the U. S. Naval Medical Bulletin that sulfonamide therapy has altered the treatment of extensive injuries to the jaws. When used, all bone fragments may be retained regardless of the degree of damage.

In the Military Surgical Manual of Standard Practice of Maxillofacial Surgery, the administration of sulfanilamide internally, and of sulfanilamide or sulfathiazole powder locally, was recommended for gunshot wounds involving the jaws. For general information on the use of chemotherapy in the prophylaxis and treatment of infection, the articles by Long (1941), Finland (1941), Janeway (1942), and Lyons and Burbank (1942) are recommended. For a review of the problems peculiar to surgery of trauma, including a discussion of the latest principles of treatment, the reader is referred to an article by Rogers (1943).

THE DEVELOPMENT IN THE FIELD OF INTRAORAL SPLINTS

It was natural that the methods of fixation used during World War I should at once be applied to fractures occurring during the new catastrophe.

Intermaxillary fixation by wiring still served its purpose well in simple fractures. Newer methods of wiring teeth have been described recently by Peterson (1943) for cases in which individual teeth have to be wired, when contact between the teeth is lacking and when the vertical height of the teeth is unfavorable for ordinary eyelet wiring.

Cap Splints.—James (1940) described the latest types of open cap splints, various sectional splints, a modified Kingsley splint, the modified Gunning splint, several vulcanite block splints, and other supports to prevent contraction, occlude openings, and provide support for the tissue. McLeod and Shepard (1941), in an article on cap splints, described their use for various types of fractures—for reduction by immediate tension of intermaxillary wires or by gradual elastic traction, and for manipulation under anesthesia.

Kazanjian (1942), in a review of his methods employed in World War I (already described), found that the type of splints he used when on active service twenty-five years ago still gave the best service today, especially in the treatment of compound comminuted fractures of the mandible. He stressed early treatment and the use of strong, simple appliances. For cases with extensive loss of the mandible and its surrounding tissue, Kazanjian (1943) employed a heavy band-and-bar splint, or constructed sectional block splints which served as a foundation for plastic procedures.

Acrylic Splints.—Acrylic block splints are used today instead of the rubber splints described heretofore. Miller (1941) of the U. S. A. Dental Corps, recommended a simple basic type as well as more elaborate types for complicated fractures, such as those requiring intermaxillary traction or expansion by means of extension arms. The latter were used when there was extensive loss of tissue and resulting contraction. Acrylic splints were also described in a booklet published by the American Dental Association entitled, *Lectures on Military Dentistry* (1941). Linn (1942) and Ferber (1943) described other types of acrylic splints useful for depressing the posterior overriding fragment. Lowery (1943) pointed out that in cases in which prolonged fixation was indicated, splints were especially useful. He gave instructions on how to construct various types, and also pointed out the advantage of acrylic resin; it is radiolucent and does not obstruct the x-rays when roentgenograms are taken of the teeth and bones with these splints in place.

Waldron (1942) concluded that for routine procedures, the employment of wiring methods rather than of dental splints was preferable because of the simplicity of application. The difficulty in obtaining good occlusion when splints were used was overcome, however, by means of the open occlusion splints made of clear acrylic resin through which the covered teeth could be observed. Others pointed out the fact that the construction of splints, the taking of impressions, and the fitting of the wax model causes delay in treatment. A factor not to be disregarded is the manipulation of the face and lips for this procedure, which causes much discomfort to the patient and is also a trying procedure for the operator. Furthermore, most civilian hospitals are not equipped for the making of splints, and the cost is of some consideration. For bone grafting or plastic operations on the jaws, however, there is no method that gives as much stability as a well-constructed splint.

Arch wire splints were described by Exner and Munz (1940). They recommended a type developed by Schroeder and Ernst in Germany during World War I, which consisted of screw bands (Angle bands) attached around anchor teeth, and an arch wire 2 mm. thick which was pushed into the tubes on the screw bands. In addition, they described accessory appliances, such as inclined planes, sliding guide planes, and hooks and buttons which might be attached by soldering to serve as connections for ligatures or elastics. Walker (1940) recommended the use of arch wires if there were teeth missing in the dental arch, if the occlusion had to be corrected by traction, or if gradual reduction was to be effected. For this purpose, some ready-made splint may be used, such as the Winter splint or the Jelenko fracture splint. The former, recommended by Winter (1943), is made of an alloy which is pliable so that it can easily be adapted to the dental arch; the other is made of stiffer material and is useful particularly if more strength and support are needed. Arch wire splints are attached to the teeth by wire ligatures and are useful especially if elastic traction is to be used to correct malocclusion. The advantages were elaborated by Buxton, Parfitt, and MacGregor (1941).

Splint for Quick Release in Emergency.—Harper (1943) described the use of the "cotter key" combined with eyelet wiring, or the continuous loop wiring of Colonel Stout. Instantaneous release was possible by simply drawing the pin on each side out of the eyelets attached to the teeth. This method is not unlike the pin and tube splint, except that it can be applied immediately.

DIRECT WIRING FIXATION OF THE FRAGMENTS

Open reduction with interosseous wiring or plating has not made any great progress as its use has been discouraged by most writers in the past (supra). The intraoral approach, however, which was favored by Kazanjian, has recently been championed by Shearer (1943) for use in edentulous cases. He advised a wide exposure of the bone so that the entire field can be observed. Holes are drilled in the "strong part of the jaw," at least ¼ inch away from the fracture. In oblique fractures a circumferential wire is employed to keep the line of fracture from changing its position. Shearer recommended this procedure for dentulous and edentulous cases; the method of fixation was sup-

In the Military Surgical Manual of Standard Practice of Maxillofacial Surgery, the administration of sulfanilamide internally, and of sulfanilamide or sulfathiazole powder locally, was recommended for gunshot wounds involving the jaws. For general information on the use of chemotherapy in the prophylaxis and treatment of infection, the articles by Long (1941), Finland (1941), Janeway (1942), and Lyons and Burbank (1942) are recommended. For a review of the problems peculiar to surgery of trauma, including a discussion of the latest principles of treatment, the reader is referred to an article by Rogers (1943).

THE DEVELOPMENT IN THE FIELD OF INTRAORAL SPLINTS

It was natural that the methods of fixation used during World War I should at once be applied to fractures occurring during the new catastrophe.

Intermaxillary fixation by wiring still served its purpose well in simple fractures. Newer methods of wiring teeth have been described recently by Peterson (1943) for cases in which individual teeth have to be wired, when contact between the teeth is lacking and when the vertical height of the teeth is unfavorable for ordinary eyelet wiring.

Cap Splints.—James (1940) described the latest types of open cap splints, various sectional splints, a modified Kingsley splint, the modified Gunning splint, several vulcanite block splints, and other supports to prevent contraction, occlude openings, and provide support for the tissue. McLeod and Shepard (1941), in an article on cap splints, described their use for various types of fractures—for reduction by immediate tension of intermaxillary wires or by gradual elastic traction, and for manipulation under anesthesia.

Kazanjian (1942), in a review of his methods employed in World War I (already described), found that the type of splints he used when on active service twenty-five years ago still gave the best service today, especially in the treatment of compound comminuted fractures of the mandible. He stressed early treatment and the use of strong, simple appliances. For cases with extensive loss of the mandible and its surrounding tissue, Kazanjian (1943) employed a heavy band-and-bar splint, or constructed sectional block splints which served as a foundation for plastic procedures.

Acrylic Splints.—Acrylic block splints are used today instead of the rubber splints described heretofore. Miller (1941) of the U. S. A. Dental Corps, recommended a simple basic type as well as more elaborate types for complicated fractures, such as those requiring intermaxillary traction or expansion by means of extension arms. The latter were used when there was extensive loss of tissue and resulting contraction. Acrylic splints were also described in a booklet published by the American Dental Association entitled, *Lectures on Military Dentistry* (1941). Linn (1942) and Ferber (1943) described other types of acrylic splints useful for depressing the posterior overriding fragment. Lowery (1943) pointed out that in cases in which prolonged fixation was indicated, splints were especially useful. He gave instructions on how to construct various types, and also pointed out the advantage of acrylic resin; it is radiolucent and does not obstruct the x-rays when roentgenograms are taken of the teeth and bones with these splints in place.

Waldron (1942) concluded that for routine procedures, the employment of wiring methods rather than of dental splints was preferable because of the simplicity of application. The difficulty in obtaining good occlusion when splints were used was overcome, however, by means of the open occlusion splints made of clear acrylic resin through which the covered teeth could be observed. Others pointed out the fact that the construction of splints, the taking of impressions, and the fitting of the wax model causes delay in treatment. A factor not to be disregarded is the manipulation of the face and lips for this procedure, which causes much discomfort to the patient and is also a trying procedure for the operator. Furthermore, most civilian hospitals are not equipped for the making of splints, and the cost is of some consideration. For bone grafting or plastic operations on the jaws, however, there is no method that gives as much stability as a well-constructed splint.

Arch wire splints were described by Exner and Munz (1940). They recommended a type developed by Schroeder and Ernst in Germany during World War I, which consisted of screw bands (Angle bands) attached around anchor teeth, and an arch wire 2 mm. thick which was pushed into the tubes on the screw bands. In addition, they described accessory appliances, such as inclined planes, sliding guide planes, and hooks and buttons which might be attached by soldering to serve as connections for ligatures or elastics. Walker (1940) recommended the use of arch wires if there were teeth missing in the dental arch, if the occlusion had to be corrected by traction, or if gradual reduction was to be effected. For this purpose, some ready-made splint may be used, such as the Winter splint or the Jelenko fracture splint. The former, recommended by Winter (1943), is made of an alloy which is pliable so that it can easily be adapted to the dental arch; the other is made of stiffer material and is useful particularly if more strength and support are needed. Arch wire splints are attached to the teeth by wire ligatures and are useful especially if elastic traction is to be used to correct malocclusion. The advantages were elaborated by Buxton, Parfitt, and MacGregor (1941).

Splint for Quick Release in Emergency.—Harper (1943) described the use of the "cotter key" combined with eyelet wiring, or the continuous loop wiring of Colonel Stout. Instantaneous release was possible by simply drawing the pin on each side out of the eyelets attached to the teeth. This method is not unlike the pin and tube splint, except that it can be applied immediately.

DIRECT WIRING FIXATION OF THE FRAGMENTS

Open reduction with interosseous wiring or plating has not made any great progress as its use has been discouraged by most writers in the past (supra). The intraoral approach, however, which was favored by Kazanjian, has recently been championed by Shearer (1943) for use in edentulous cases. He advised a wide exposure of the bone so that the entire field can be observed. Holes are drilled in the "strong part of the jaw," at least ¼ inch away from the fracture. In oblique fractures a circumferential wire is employed to keep the line of fracture from changing its position. Shearer recommended this procedure for dentulous and edentulous cases; the method of fixation was sup-

plemented by a plaster cast to fit the head and chin. Gordon (1943), who also recommended this method, used stainless steel sutures, reporting that in the reduction of 7 malar, 2 maxillary, and 15 mandibular fractures (1 condylar), only three infections occurred, two in the soft tissue, and one in the bone, a case of angle fracture which developed osteomyelitis. He concluded: "Wire sutures allow accurate reduction and fixation, and control fragments that otherwise would be difficult to manage."

Circumferential wiring, which has proved to be a very successful method (supra), was again advocated by Williams (1942).

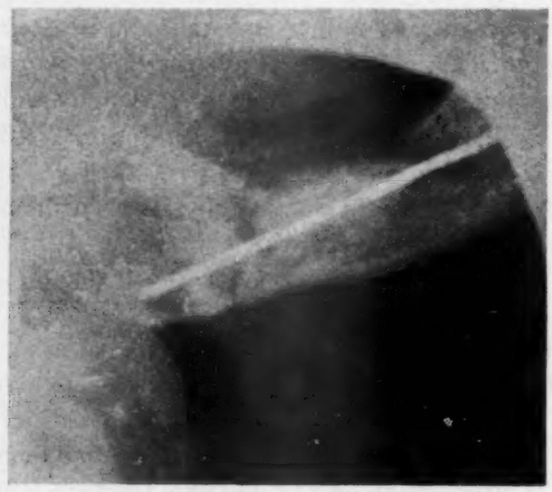


Fig. 51.—Intraosseous wire fixation. (Courtesy Dr. Bradford Cannon, Massachusetts General Hospital, Boston.)

INTRAOSSEOUS WIRE FIXATION FOR TRANSFIXATION OF THE FRAGMENTS

In intraosseous wire fixation a Steinmann pin or a Kirschner wire is drilled across the fracture line. Multiple wires are used in multiple fractures. The method was described by Ipsen (1933), Meade (1935), and Søbye (1939). Brown and McDowell (1942) stated that they found intraosseous wire fixation to be of major service in the fixation of difficult jaw fractures. They recommended it when there were an insufficient number of teeth for interdental wiring, in severe fractures to avoid complicated appliances and wide open reductions, or when it was desirable that the patient be able to open his mouth. It might be used as an accessory method, or when horizontal wiring or arch bars were used to prevent rotation or displacement; it was also thought by Brown to be the simplest method to take care of the posterior displaced segment in angle fractures, and to stabilize fractures in edentulous jaws (Fig. 51). Secondary wires might occasionally be necessary. They advocated the use of this method also for certain maxillary fractures, the wire being inserted transversely through the cheek. Waldron (1942) recommended the use of a transverse Kirschner wire inserted through the symphysis to hold the mandible forward and in occlusion in bilateral fractures of the ramus, or in fractures of the condyle when the anterior teeth were loosened and interdental wiring was not practical. As in maxillary wiring, the wire ends protruding through the side of

the chin, or the cheek, might be attached to a head apparatus for stabilization (Fig. 79).

The insertion of the wires requires the best possible asepsis. The jaw should be held by an assistant and not by the operator who drills the wire into the jaw, so that the wire will not be contaminated with mouth secretions. The reduction of the jaw should be done first and must be accurate, as no adjustment will be possible later. Likewise, while drilling the wire, for which a hand engine or an orthopedic electric engine was recommended (a dental engine does not have enough power), the fragments must be held in accurate position. The drill must not be allowed to become overheated or bone necrosis results.

Fig. 52.—Pincock's "pin guide" clamped into position to insert Steinmann pin through the anterior part of the mandible for immobilization by means of bars extended on each side to a headband.

Pincock (1943) devised a "pin guide" which can be clamped into position to direct the wire accurately into the desired place in the bone (Fig. 52). The wire, after it is inserted, may be cut short and covered by skin until removed. Pincock wrote that it was surprising how firmly the pins were held in position when he tried to remove them after six weeks, and that no infection had occurred in the twelve completed cases which he reported. Brown reported occasional small abscesses beneath the fracture sites and small localized areas of osteomyelitis, but he believed these were due to technical difficulties and were not serious. Pincock stated that an effort must be made to avoid the mandibular canal, but if entered, he thought that the wire would push the nerve aside rather than injure it. He has found no alterations in the degree of numbness of the lip associated frequently with mandibular fracture.

EXTERNAL SKELETAL FIXATION

The basic principle of this method was originated by Parkhill (1897 and 1898), who described a "bone clamp" for various long bones of the body. It is a method in which the fragments are controlled by means of pins or screws

inserted through the skin. Roger Anderson (1936) further developed this method to meet the urgent requirements of air and sea warfare, and to facilitate the evacuation and transportation of patients with securely immobilized fractures. This method was modified by Waknitz of the American Hospital in Britain to be used for the mandible. Converse and Waknitz (1942) described their appliance as being particularly useful in the control of the posterior edentulous fragment. They used stainless steel wires inserted through both cortices by means of an electric drill. In the United States, Fairbank and Stout of the Dental Corps, U. S. Army, developed the "Frac-Sure splint" which is readily adjustable to fractures of the mandible (Fig. 53). Another variation of this type of apparatus was described by Clouston and Walker (1943). It was used at the Maxillofacial Center in Basingstoke, England, by Rushton and Walker (1942). After using this method, they concluded that it should be reserved for (1) multiple fractures of the edentulous or newly edentulous mandible; (2) fractures in which there is a posterior edentulous fragment which cannot easily be controlled; and (3) patients in whom it is necessary to control edentulous fragments for bone grafting.

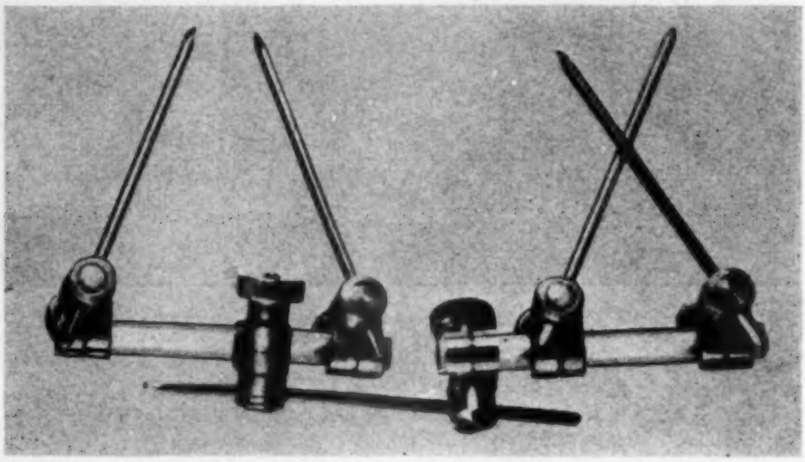


Fig. 53.—Waldron's splint with lucite connecting rods for skeletal fixation. (From Waldron, Kazanjian, and Parker, J. Oral Surg. 1: 59, 1943.)

Waldron (1942) described a modification of the Converse-Waknitz apparatus in which he used vitallium screws attached to a crossbar by means of universal joints (upper unit No. 56, Starrett surface gauge). He wrote that Ivy suggested the use of a lucite rod which could be heated and bent, to align the pins. Waldron then devised an appliance with one such rod to hold each pair of pins, which in turn were united by means of a steel fixation rod with two additional Starrett joints (Fig. 53).

In 1931, Stader, a veterinarian, developed an apparatus which was applied to orthopedic surgery by Lewis and Breidenbach (1942). A series of forty cases was reported by Shaar and Kreuz (1942), and the application of the apparatus in question was described in their monograph (Shaar and Kreuz, 1943).

Another appliance in which the pairs of pins are held in blocks is that described by Haynes (1939), and its modification, the Haynes-Griffin apparatus, was described by Griffin (1941). Thoma (1942) wrote that the alignment of the four pins allowed only limited deviation, otherwise the adjustment bars would not fit. He stated that this can be remedied, however, by using ball socket bars on both blocks and an 11 gauge wire to make the connections (Fig. 54). This method can be used in multiple fractures when more than two pairs of pins are required.

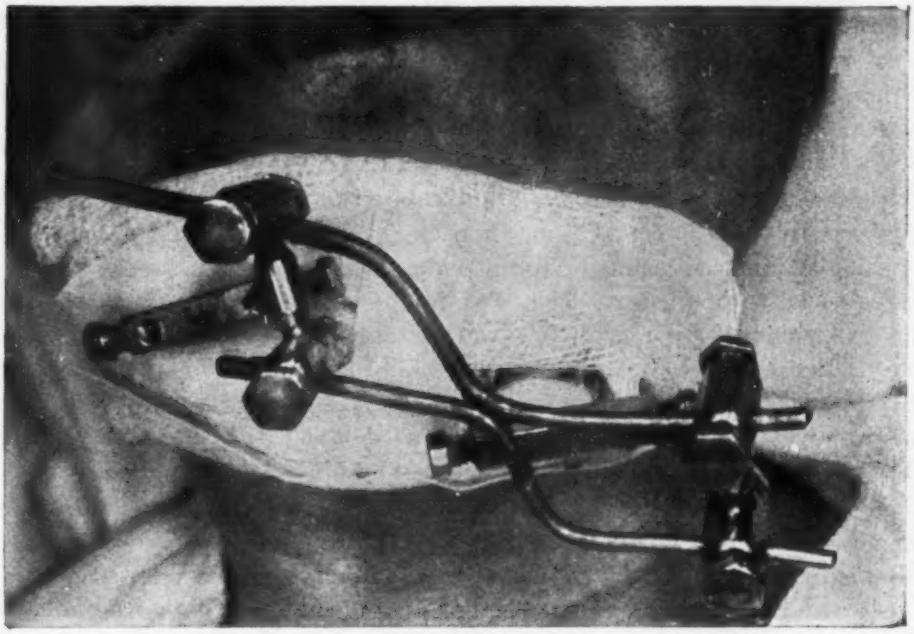


Fig. 54.—Griffin appliance modified by Thoma by the use of 11 gauge German silver wire in four ball socket bars. (From Thoma, Traumatic Surgery of the Jaws.)

A method that allowed for adjustment of the attachment of the pins in the block was described by Mowlem, Burton, MacGregor, and Barron (1941). The pins, which are Kirschner steel wires, were held in attachments that could be moved in the slot of a metal plate, which in turn was attached to its mate by an adjustable bar. The pins were inserted so that they crossed each other at an angle of about 60 degrees. The use in nineteen cases was reported.

Among other appliances for skeletal fixation is that designed by Berry (1941). He developed a method of vertical implantation of vitallium screws into the alveolar ridge of edentulous mandibles, connecting them with alignment rods by means of sleeves that were fastened by wires. This method was extended by Berry (1942) to extraoral application; however, it did not give as secure fixation as some of the other methods described. Logsdon (1942) made a report of five cases treated by the intraoral application of this apparatus, and reported that there was union in six weeks in spite of the fact that four of the cases were complicated fractures. Slight necrosis, which occurred around the pins after the third week, was ascribed to pressure. Logsdon (1943) also reported the external use in four cases. In single fractures one

fragment was held by one screw, the other by two; while in double fractures only four screws were used, but all were connected by a single bar. All were compound fractures and the percentage of undesirable complications, Logsdon wrote, was no greater than one might expect in a similar group treated by the older methods.

Wood screws have been used by Brown and McDowell (1942) with a bar attached by means of special lugs. They stated that this method was useful in shattering injuries to attach and save major fragments of the bone. It often can be used in combination with the intraosseous Kirschner wires. Bigelow (1940) reported the use of screws (one in each fragment) held by a splint or incorporated in plaster; later (1943) he used screws with a slotted head to accommodate a bar held by a nut. It was a simple, light apparatus with the disadvantage that the alignment rod had to be bent in order to fit into the slots, which made accurate reduction difficult.

Bourgoyne (1943) also used a combination of screws and plaster; the screws were made of vitallium, however. Godwin (1944) described some deviations. He used a plaster splint which consisted of a bandage 1 inch wide, impregnated with plaster. This was wrapped around the screw shanks and then re-enforced with plaster or "rapid stone." He recommended, when possible, reduction of the fracture by intermaxillary wiring or by means of intermaxillary elastics, if complete reduction could not be obtained at once. In this case, application of the plaster splint was delayed until occlusion was established. Edentulous fragments were aligned by digital manipulation.

Advantages of Skeletal Fixation.—The advantages of skeletal fixation are numerous. Winter (1943), in a report on thirty-six patients treated with skeletal fixation, stated that it made early and prompt reduction possible, since it required a minimum of complicated equipment and therefore could be applied in dressing stations, field hospitals, evacuation hospitals, or on shipboard. Of first importance in war surgery, he stated, was the fact that with this method the soldier with a mandibular fracture may be transported after the fracture has been reduced without endangering his life from sea or air sickness. Secondly, because the bone is immobilized but the joint is free, moderate function is possible, which is a great advantage not only because it provides better nourishment for the patient at the same time eliminating the time-consuming preparation of liquid diets, but also because it favors healing. Haynes (1939) pointed out that callus formation may be expected earlier, and we know that the use of a bone increases the inflowing calcium, and counteracts the atrophy that occurs from disuse. At the same time, since the joints are not immobilized, patients are not affected by muscular trismus, which so frequently prolongs the period of disability. This was pointed out by Amies (1942), who stated that the use of physiotherapy had become a very important adjunct to the A.I.F. Faciomaxillary Unit at Kantara.

Application of Skeletal Fixation.—The use of this method, most writers pointed out, should be reserved for cases in which other types of treatment are not applicable.

Gillies (1941), in summing up the work at the British Maxillofacial Centers, concluded that skeletal fixation would definitely have a permanent place along

with other methods. Among the disadvantages, he mentioned: (1) local necrosis, which he believed was due to corrosion of a pin wire, or the heat generated when the bone was drilled. The area involved, however, is very small and in a place that has no bearing on the treatment of the fracture. (2) Difficulty in late reduction of a fracture; this is not actually due to ineffectiveness of the apparatus but may be due to impaction or binding of the bone fragments in a false position by scar tissue. Both are conditions that can be remedied. (3) Pinpoint scars which he states are easily dealt with if they should be offensive.

Waldron, Kazanjian, and Parker (1943) concluded that the use of this method is indicated: (1) in badly displaced fractures of the edentulous mandible, particularly when they are comminuted; (2) in fractures behind the angle of the jaw, when the posterior fragment becomes difficult to maintain in reduced position; (3) in certain types of multiple fractures involving both upper and lower jaws, when other methods are not satisfactory, because of the loss of teeth; (4) in comminuted fractures of the mandible with destruction of a section, wherein the isolated part cannot be held adequately with dental splints; and (5) when facilities for constructing dental splints are not available.

Additional advantages pointed out by others are as follows: Mowlem, et al. (1941), stated that the method facilitated oral hygiene, simplified feeding, and prevented stiffness of the joint and muscles. Griffin added that gingivitis and erosion of the teeth, frequently seen when dental ligation or splints were used, was avoided, and that in compound fractures and fractures with extensive wounds, drainage, inspection, and irrigation were easily made, and that general anesthesia might be used for the reduction or other necessary procedures without fear of the nausea and vomiting that might result. Gillies stressed the perfect control of the fragments into which the pins were inserted, and the easy anatomic positioning. In one case in which a bone graft had become badly displaced, he obtained perfect union after revision and the use of external pin appliances.

The Technique of Applying Skeletal Fixation.—General or local anesthesia may be used and as Winter stated, the anatomic landmarks should be observed for study of the fracture, and roentgenograms should be taken from various angles. The location of the external maxillary artery and vein, the facial nerve plexus, the mandibular canal, the mental foramen, and the parotid gland should be noted, as well as the exact location of the underlying fracture, its direction, and its displacement. Bradford and Wilson (1942) in a general article on skeletal fixation, stated that a new method should be studied from the standpoint of its harmful possibilities as well as its benefits. They considered the following points important: (1) The most rigid rules of asepsis should govern the introduction of the pins. (2) In applying the pins, care must be exercised to see that they penetrate all the way through the bone. Unless both cortices are penetrated, pins move within the bone, causing irritation and inviting infection. (3) The danger of distracting a fracture must be guarded against. If a space is seen in the check-up roentgenograms, the fragments must be brought together by forced impaction, or union will be delayed. (4) A small amount of discharge (seepage) at the pin wounds should not be obstructed and the original dressing around the pins should not be disturbed. Shaar and Kreuz (1943) believed that seepage might occur if the pins were introduced into

previously traumatized or devitalized soft tissue, or if the pins were not firm in the bone. They gave a list of errors in treatment that should be avoided. The most important are: (1) Failure in reduction because the anesthetic employed gives inadequate relaxation. (2) Errors in pin placement—too close to fracture line. (3) Failure to apply firm, steady pressure while inserting the pins. (4) Failure to keep about 1 cm. from the edge of the mandible for placing the pin. (5) Failure to attain accurate reduction by intraoral manipulation. (6) Failure to check occlusion before connecting the splint. (7) Allowing excessive use of the mandible, which causes unnecessary strain on the pins and may produce loosening and displacement of the bone. They stated that dimpling, often seen in some cases at the pin-insertion point, might be due to seepage.

The operative procedure was well described by Clouston and Walker (1943). Two operators are most desirable, and every aseptic precaution must be exercised. The landmarks are drawn on the skin while one operator inserts one hand within the mouth beneath the sterile drapings. He holds the jaw and controls the fragments to prevent further trauma while the pins are inserted by the second operator. The pins must be placed at the correct point near the lower border of the mandible, below the apices of the teeth and the mandibular canal, and far enough from the fracture line and from infection to avoid complications. Winter recommended that the pairs of pins should be inserted at an angle of 70 degrees, and in order to insert them at the correct distance he used pins with circular marks.

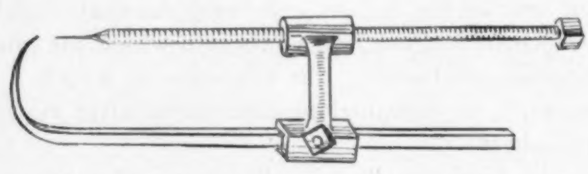


Fig. 55.—Extraoral splinting by means of a hook screw invented by Pohl. (From Pohl, Lancet 2: 389, 1941.)

The Hookscrew Attachment of Pohl.—A method of skeletal fixation based on an entirely different principle was reported by Pohl (1941). He used a hook screw made of stainless steel (Fig. 55). The hook was inserted through the skin on the inner surface of the mandible into the cortex of the bone, while the screw which ends in a pin was screwed tight into the outer surface, taking firm hold of the jaw without penetrating the spongiosa. After the fracture was reduced, a crossbar of stainless steel was welded to the screws. Waldron, et al. (1943), believed this method might have some value in controlling friable fragments, or for fractures in children where the insertion of half-pins might injure the permanent teeth.

The Brenthurst Clamp Splint of Penn.—An appliance constructed on a similar principle has been recommended by Penn and Brown (1943). It consists of a clamp and adjusting bars, universal joints, coupling apparatus, manipulating handle, spanner, and key. The advantages of this splint as set forth by the authors are as follows: The attachment of the clamp to the inferior or posterior borders of the ramus can be accomplished without injuring any important

anatomic structures, without opening any fascial planes for the spread of infection (the presence of infection does not contraindicate the use of the splint), and without taking any operative risks. There is no chance of bone burn, injury to tooth roots, or the mandibular nerve. It may be applied to the jaw of a child without injuring the developing teeth. It is particularly useful in cases requiring resection of portions of the mandible, or the application of bone grafts. The reduction handles, designed to hold the clamp during its application, also serve for the manipulation of grossly displaced fragments.

COMMINUTED FRACTURES OF THE MANDIBLE

More radical treatment of fractures is favored today by such men as Sir Harold Gillies; and, indeed, with modern ways to inhibit and prevent bacterial infection, more daring methods are permissible. How such a treatment prevents complication and shortens the period of treatment is evidenced by the following report of Cuthbert (1944) of Cape Town, Africa. He contrasts an analysis of two series of cases, the first consisting of eleven cases treated in 1940 to 1941 by conservative methods, and the second, of fourteen similar cases treated between 1942 and 1943 in a more radical manner. The first series, of which five had not united after thirty-six weeks, and six required twenty-eight weeks to get union, presented a marked contrast with the treatment time of sixty-six consecutive cases of noncomminuted fractures in which bony union was obtained in an average of eleven weeks. In examining the records of the first series, it was noted that the main causes of delayed or nonunion were suppuration and sequestration. In the second series, the aim was to avoid sequestration by anticipating it, and abscess formation by providing early dependent drainage of the fracture by submandibular incision. For cases in which bone grafting was not thought to be required later, the fractures were exposed by wide submandibular incisions, all completely detached pieces of bone removed, and all thin and tapering edges of compact bone nibbled away. After the wound was débrided of blood clot and badly bruised soft tissue, a soft rubber drain was inserted while the main fragments were fixed by intraoral or skeletal fixation. Bone grafting was planned in cases which showed gross comminution of the whole depth of the mandible over a length of ½ inch or more, and particularly if it was associated with a contaminated external wound. In these cases, after débridement and removal of all loose bone, the bone ends were trimmed square, leaving a clear gap which was packed till healed by granulation. During this time the mandible was immobilized by intraoral or skeletal fixation. As soon as the soft tissue wound had healed (in the reported cases after three, eight, nine, twelve, and fourteen weeks) pyramidal chips of cancellous bone from the ilium, about 1 cm. long, were packed between the freshened bone ends, and the wound closed by suture. The more radical treatment yielded union in an average of ten weeks, sequestration was rare, and delayed union or nonunion completely absent.

MAXILLARY FRACTURES INVOLVING THE MIDDLE THIRD OF THE FACE

The trend here is away from external accessory appliances for fixation of the bones of the face. Adams (1943) stated that in using numerous types of extraoral appliances, including plaster head caps for stabilizing fractures, he found them all complicated and time-consuming in their preparation and ap-

plication. Besides being cumbersome and uncomfortable for the patient, some were easily disadjusted and dislodged. The fact that so many different types of appliances were being used suggested that this method was not entirely satisfactory. Kazanjian (1927), Morgan (1934), Schaefer (1935), Major (1938), Woodard (1939), Davidson and Brown (1940), Henry and Fairfax (1941), Crombie (1941), Richardson (1942), Waldron (1942), Padgett (1942), Yando and Taylor (1942), Freeman (1943), Parker (1943), and Bisnoff (1943) described headbands and caps of various types.

The fact that maxillary fractures were frequently associated with fractures of the malar-zygomatic compound was pointed out by Balkin (1942), who described various methods of treatment. These fractures occurred not only in automobile and sport accidents, but also in modern warfare. The civilian population sustained these injuries as a result of aerial bombardment, and the men of the Armed Forces because of accidents of the mechanized divisions and the action of missiles. McIndoe (1941) classified fractures of the middle third of the face into fractures of the *malar maxillary area*, and fractures of the *nasal maxillary area*. In the Maxillofacial Unit, East Grinstead, twenty-six of the first type, and forty-three of the second type were treated between Sept. 3, 1939, and July 1, 1941. Erich (1942) spoke of (1) *transverse maxillary fractures*, in which there is a complete separation of the maxilla from the rest of the skull; (2) *pyramidal facial fractures*, which extend upward through each antrum to the ethmoid region and base of the nose; and (3) *transverse facial fractures* passing through the base of the nasal and ethmoid region and across the orbits to the zygomatic arches. Combinations of all three types might occur, and the entire middle third of the face might be a comminuted mass. Complete transverse fracture of the maxilla might be complicated with separation in the midline of the palate or separation of large alveolar segments.

Associated Injuries in Fractures of the Maxilla.—Statistics regarding maxillary fractures were scarce. Adams (1943) reported eighty-five fractures of the maxilla which had associated injuries (see Table VII).

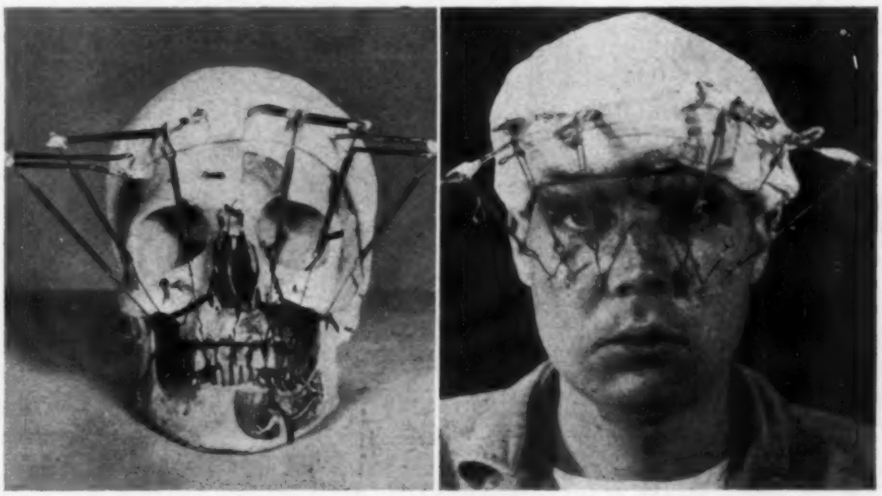
TABLE VII

ASSOCIATED INJURIES IN FRACTURES OF THE MAXILLA

YEAR	NUMBER OF CASES	FRACTURE OF MANDIBLE	FRACTURE OF ZYGOMA	FRACTURE OF NASAL BONES	FRACTURE OF SKULL	FACIAL LACERATIONS	INFECTION WITH DRAINAGE	DEATHS
1934	4	1				3		
1935	8	3	3		1	6		1
1936	5	1	3	1		3		
1937	4	1	3	1	1	1		
1938	12	2	3	3		9	1	
1939	13	2	3	3	1	10		1
1940	17	2	2	4	1	11	2	1
1941	22	7	5	4	1	17	2	
Total	85	19	22	16	5	60	5	3

Reduction of Maxillary Fractures.—It was stated that reduction of these fractures was found difficult, particularly as they were generally not seen until late. McIndoe (1941) stated that early operative interference was contraindi-

cated in concussion or other serious complication such as cerebrospinal rhinorrhea, which was due to fracture of the cribiform plate of the ethmoid bone. Infection might lead to fatal meningitis. Erich stated that only after the fracture in the ethmoid region had become walled off by fibrous tissue (in about two weeks) was it safe to reduce and immobilize the fractured bones of the face. Otherwise it was important, as pointed out by Parker (1943), that maxillary fractures, especially those with posterior displacement and with impaction from a crushing injury, be reduced as early as possible. Gillies (1941), commenting on early reduction, stated that it should be performed as soon as the period of shock had passed. "It will take a long time to convince the surgical profession in general that it is justifiable and correct to replace these maxillae even in the presence of severe head injuries." He cited Cone who was fully convinced that the replacement of all displaced bones added to safety because of the natural drainage established by proper disimpaction and replacement. Kingsbury (1944) insists that in the presence of intracranial injuries, reduction should be undertaken in a supine and not in a sitting position.



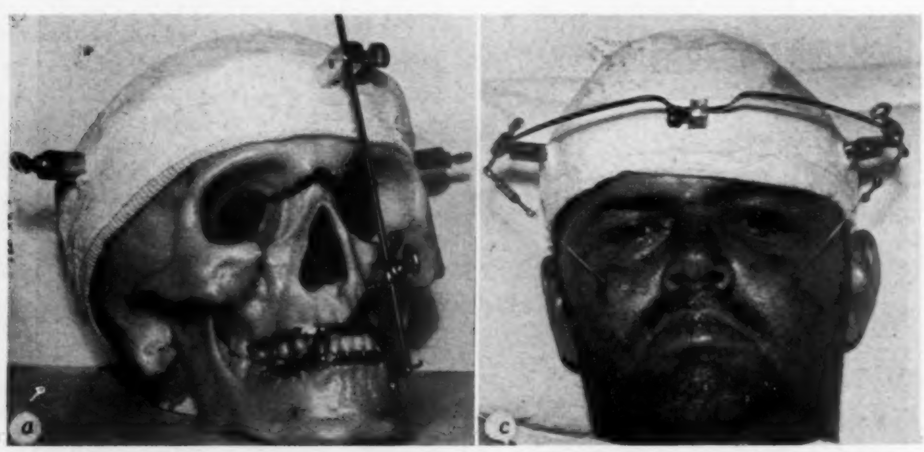
Figs. 56 and 57.—Dingman's method of traction for maxillary fractures. (From Dingman, J. A. D. A. 26: 173, 1939.)

Elastic Traction.—Traction gave excellent results in cases in which reduction had been delayed. For low horizontal fractures of the maxilla with upward and backward displacement, Thoma (1942) recommended reduction by intermaxillary traction with Kazanjian buttons or Jelenko splints attached to the teeth, and an accessory head bandage with elastic traction on each side over the cheek. The first effected normal occlusion; the latter aided in stabilization of the upper jaw.

For cases with downward displacement, Major (1938) recommended skeletal traction in addition to intermaxillary elastics. This he applied by inserting a Kirschner wire transversely into the symphysis of the mandible. By this means a tremendous force could be applied with S-shaped hooks attached to the Kirschner wire and fastened to a head cap. A turnbuckle served to shorten

the rods in order to reduce the fracture gradually. Dingman (1939) recommended a method similar to that devised by Federspiel (1934) for cases with downward displacement. The latter consisted of fastening a plain arch wire to the necks of the teeth from which strands of copper wire were attached and passed through the cheek to the outside of the face; then they were twisted together over a plaster head cap until the fracture was reduced. Dingman's method was to attach Winter arch bars to both the upper and lower teeth for intermaxillary traction, as well as silver wires which were passed through the cheek to be fastened with elastics to rods extending from a plaster cap (Figs. 56 and 57).

Erich (1942) made an important improvement by using adjustable hooks attached to the head cap; this prevented the wires from cutting into the soft tissue and forming a scar if they did not come out of the skin exactly at the right place. In edentulous jaws Erich recommended that the wires be attached to the flanges of the patient's artificial denture or a rubber splint (Figs. 58 and 59).



Figs. 58 and 59.—Erich's method of traction useful for maxillary fractures. The apparatus in Fig. 58 is used for forward traction, that in Fig. 59 for vertical support. (From Erich, J. A. D. A. 29: 783, 1942.)

Internal Wiring Fixation.—Adams (1943) wrote that until two years ago his treatment included the use of extraoral appliances, but since then open reduction and fixation by wiring of the fractured parts to the neighboring unfractured bony structures have been carried out in most cases. For this method he claimed facility of operation and attainment of complete immobilization; it followed sound surgical principles, and required easily available instruments. Repeated adjustments were unnecessary and the patient was spared the discomfort and inconvenience of head gear and rods around his face; therefore he could resume his activity after he had recovered from the acute stage of the injury. The main effort was directed toward obtaining a correct reduction of the fractured maxilla, after which the immobilization of secondary fractures offered little difficulty.

The method for simple horizontal fractures not involving the orbit consisted in passing a stainless steel wire, No. 35 or 26, through a small hole made

in the infraorbital ridge through a short incision. The wire was passed along the anterior wall of the antrum under the skin, through the mucosa of the upper sulcus, buccally, to the second molar. After the fractured bone was placed in position, the wires were fastened on each side to an arch band attached to the necks of the teeth. Intermaxillary elastics might be applied if the occlusion needed to be corrected, or in case of multiple fractures.

If the fracture involved the zygoma or infraorbital ridge, the wire was inserted into the supraorbital ridge just above the zygomatic-frontal suture. Through a short incision, a small hole was drilled at this point; through this the wire was inserted and looped over the ridge to be passed beneath the temporal surface of the malar bone. This was best done by means of a bent, malleable dissecting probe, the eyelet of which served to carry the wire into the mouth through a small incision in the reflection of the mucosa. If immediate reduction was possible, the wires were attached, one on each side, to an arch band fastened to the upper teeth (Fig. 81), or if the patient wore artificial dentures, to the outer flanges of the latter. These wires were removed by cutting the loop at the place of insertion and drawing them down into the mouth, so as not to introduce infection into the face.

In fractures involving the displacement of the malar bones, Adams advised the use of stainless steel wires, passed through holes made in each fragment near the fracture line. This would reduce the fracture and hold the bone in normal position. Gordon (1943) has reported the reduction of seven malar fractures by this method.

The treatment of nasal fractures and fractures of the malar bones, and the handling of severely comminuted fractures of the middle third of the face were discussed in articles by Kazanjian (1927), Blair et al. (1937), Brown (1939), Gillies (1941), Padgett (1941), McIndoe (1941), and especially by Erich (1942). The treatment of healed deformities was dealt with by Soderberg (1943).

TEN COMMANDMENTS FOR THE CARE OF PATIENTS WITH INJURIES OF THE FACE AND JAWS

Since the material presented in this review is almost exclusively an expression of the opinion of those who have written on the subject, and because some of these opinions are controversial, I shall conclude this paper by setting forth some of the principles which I believe are important in the treatment of fractured jaws.

The aims of treatment should be to restore both appearance and function. While the patient's happiness and success in life depend a great deal on his facial appearance, he also must be able to eat. His ability to masticate is subject to the function of the mandibular joint and the muscles of mastication. Trismus of the muscles, caused by long inactivity or infection, often prolongs the period of disability, while malocclusion resulting from poor reduction may hinder mastication permanently, and cause serious damage to the teeth. A good functional result therefore is just as important as a good cosmetic result.

The following are ten commandments to be observed in the treatment of fractured jaws:

I. TREAT THE PATIENT

The patient's general condition should be considered first. Serious accidents are generally associated with shock, which may be over within ten hours, and secondary shock which may supervene several hours later. Shock generally is caused by hemorrhage and loss of fluids from wounds in compound fractures, and from burns. Shock in combat zones is aggravated by fear, anxiety, hunger, and lack of rest.

The treatment consists in placing the patient in a recumbent position, giving bed rest as soon as possible, maintaining body heat, and reducing pain with morphine unless contraindicated. Immediate transfusion of saline solution or plasma should be given, and hemorrhage should be stopped. A blood transfusion before an extensive operation is helpful to debilitated patients. Care should be taken that unskillful handling and rough transportation does not cause secondary hemorrhage. To prevent this, bandages and prophylactic splints should be applied.

II. ATTEND TO SOFT-TISSUE WOUNDS

First aid should consist in control of hemorrhage or oozing by means of pads of sterile gauze bound in place with a bandage, such as a cravat or four-tailed bandage. Sulfanilamide may first be dusted into and on the wound. If it is not available, a solution of merthiolate or zephiran may be placed in and over the lacerations. Badly lacerated wounds should not be sutured in compound fractures, until at least temporary fixation of the fractures has been accomplished, because traction caused by the skin may produce marked displacement, and movement of the fragments may cause hemorrhage and hematoma under the skin with resulting infection requiring incision and drainage. Advanced fracture treatment consists of the removal of foreign bodies, detached pieces of bone, and fractured teeth. Irrigation with saline solution is advantageous, but débridement should be carried out with restraint.

III. MAKE A CAREFUL CLINICAL EXAMINATION

A thorough history of the accident should be taken either from the patient or an observer. The cause of the injury may give important information and become a guiding factor in treatment; one should know the type of foreign body that may have entered the tissue, and the character of contamination that may therefore be expected. It is important to find out whether immediate unconsciousness for any length of time followed the accident. Unconsciousness points to concussion or contusion of the brain. If the patient had an interval of consciousness preceding unconsciousness, a hemorrhage probably is the cause. In such cases unconsciousness generally deepens. In very severe injuries there may be laceration, and in both contusion and laceration there is blood in the cerebrospinal fluid. Fractures of the skull should be suspected and looked for; these may involve the vault or the base of the skull. The fracture of the base is more serious than fracture of the vault, because vital parts may be endangered. Fractures involving the middle cranial fossa may be due to the fact that the mandibular condyle has been forced through the glenoid fossa by a

blow on the chin, or to fracture of the petrous portion of the temporal bone. In such cases, hemorrhage or cerebrospinal fluid may be discharged from the ears, the facial and auditory nerves may be injured, and the optic nerve may be involved with resulting blindness. In fractures involving the anterior fossa, ecchymosis of the lids occurs with subconjunctival hemorrhage if the orbital plate of the frontal bone is broken; however, this sign may be due also to fracture of the malar bone, especially when it involves the external or inferior border of the orbit. If the cribriform plate is fractured, hemorrhage or cerebrospinal fluid will escape (Fig. 60) from the nose (cerebrospinal rhinorrhea), and hemorrhage may be found beneath the pharyngeal mucosa. Conjunctival hemorrhage with ecchymosis mainly involving the suborbital area indicates a transverse facial fracture with involvement of the infraorbital ridge.

Fig. 60.—Middle-third face and mandibular fractures with cerebrospinal rhinorrhea and dilated fixed pupils, blindness in the left eye, and paralysis of the sixth nerve. After reduction, the ophthalmologic signs disappeared gradually and completely.

Ophthalmological signs are of importance. Failure of the pupils to react is a bad sign; unilateral dilation and fixation of the pupil (Fig. 60) draws attention to the side where the intracranial injury has occurred. Blakeslee (1929), in a comprehensive study of 595 cases at the Harlem Hospital in 1929, showed that the mortality was 95 per cent in patients exhibiting bilateral dilated and widely fixed pupils, while it was 50 per cent in those with one fixed and dilated pupil. Diplopia is generally due to downward displacement of the eye, which indicates destruction of the floor of the orbit and comminution of the maxilla in general. Other eye manifestations of head injuries have been described recently by Lyle (1943).

Neurological signs should be carefully recorded. Injury of the facial, the abducens, the auditory, the motor oculi, and the optic nerves may occur. If

they are compressed by edema only or by displaced bone, the paralysis may be temporary; if the nerves are completely severed, it will be permanent. Divisions and branches of the fifth nerve are frequently affected. The area of anesthesia should be carefully noted. In lateral mandibular fractures, numbness of the lower lip and chin is common; in fractures of the middle third of the face, the numbness may affect the nose, infraorbital region, upper lip, and, more rarely, the hard and soft palates.

IV. DETERMINE THE TYPE AND EXACT LOCATION OF THE FRACTURE

Deformity caused by a fracture should be observed and differentiated from soft-tissue swelling. The mobility of the bone should be tested by bimanual manipulation of the mandible, by introducing two fingers into the mouth and taking hold of the upper jaw, by palpating the region of the mandibular joint in front of the tragus of the ear, and by feeling the orbital ridge. Crepitus may or may not be present. It is not wise to manipulate excessively because this may cause new hemorrhage or dislocation. The occlusion and condition of the teeth should be carefully observed, especially should luxation and fracture of individual teeth or entire segments be detected. The relation of the upper to the lower denture often gives important information. Openbite is seen in condylar fractures and horizontal fractures of the maxilla. Retrusion of the maxilla is seen in middle-face fractures, retrusion of the mandible in bilateral condylar fractures. Deviation of the jaw generally indicates unilateral fracture. Displacement of fragments interferes with occlusal contact of the teeth.

Roentgen examination is indispensable. Its routine use saves much time for the diagnostician and discomfort to the patient. It should include views from various angles: anteroposterior and posteroanterior views, lateral skull. and lateral jaws showing the horizontal as well as the vertical rami including the condyle, and views from Water's position, and exaggerated Water's position as indicated. Dental films should be taken, if possible, to disclose injury and infection of the teeth. Stereoscopic x-rays are of great help in locating foreign bodies, especially if indicators are previously inserted into the tissue.

V. PREVENT AND TREAT INFECTION

Simple fractures of the jaws do not generally present serious problems of infection. In compound fractures, thorough, although conservative, débridement of the soft-tissue wound, including the removal of foreign bodies, irrigation, and early immobilization greatly minimize the incidence of infection. The local application of 1 part sulfathiazole and 2 parts sulfanilamide is recommended. If there are intraoral wounds, the presence of Vincent's infection should not be overlooked, and if fractures are compounded into the mouth, a smear should be taken if the gingivae look suspicious.

Chemotherapy by intravenous administration, 5 Gm. of sulfadiazine in 100 c.c. of sterile distilled water, or by the oral route, 2 Gm. of sulfadiazine given at once and 1 Gm. every four to six hours, should be instituted in all compound fractures whether bone infection is evident or not, and in all cases in which there

is a hemorrhage from the ear, in which cerebrospinal rhinorrhea is present. A blood level of 6 to 8 mg. per 100 c.c. should be maintained. In staphylococcic infection the use of sulfathiazole may be found more satisfactory. Penicillin

Fig. 61*A*.—Patient with fistula from septic fracture.

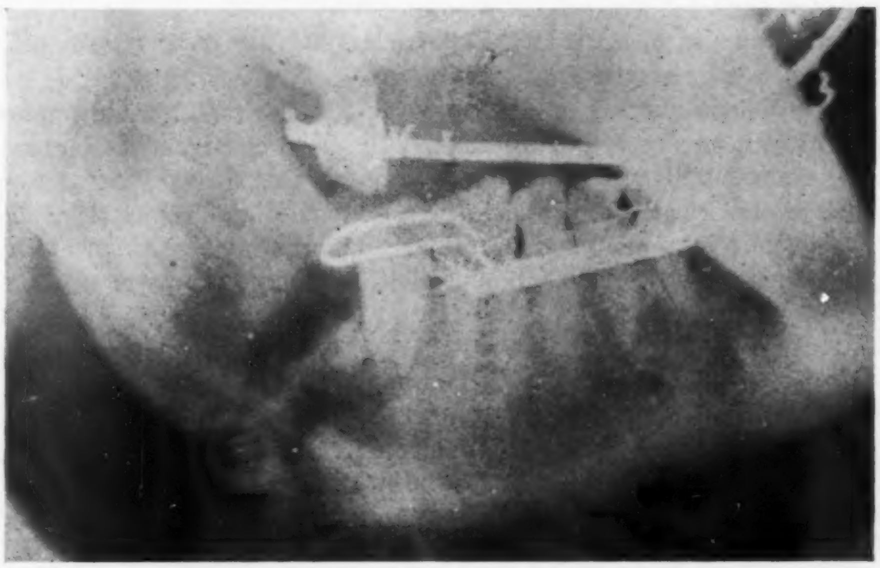


Fig. 61*B*.—X-ray of patient's jaw shows osteomyelitis in fracture line and involved tooth.

when freely available may be found to be an improvement over the sulfonamides. Advice regarding its use is given by Lyons (1943). My experience is limited to three cases—two septic fractures, and one case of osteomyelitis of the ramus. In all, excellent results were obtained with penicillin after all other methods had failed.

Supportive treatment should be given as indicated. Blood transfusions are indicated in septic fractures, especially when the patient has a lowered resistance, or if he shows evidence of debility. Serious local infections may come from wounds of the face or in the mouth, since all face and jaw wounds are potentially infected. By far the greatest source of infection comes from teeth involved by the fractured bone. Any fracture through an alveolar socket or an impacted tooth should be considered a compound fracture which may be the cause of complications that manifest themselves as cellulitis, abscess formation below the fracture line, and, later, osteomyelitis. Any persistent and progressive inflammatory process with fever is generally due to lack of drainage. Hot fomentations should be applied, and incision and drainage are indicated if pus causes fluctuation. Extraoral incisions are also indicated in cases of osteomyelitis, and even if there is only a fracture hematoma beneath the jaw. A persistent fistula (Fig. 61*A*) is due to the presence of either a sequestrum (Fig. 61*B*) or a nonviable or infected tooth. Delayed union or nonunion is frequently caused by teeth which are allowed to remain in the fracture line, and a very radical attitude toward the extraction of such teeth is justified, especially as we now have methods available for the stabilization of displaced fractures which do not depend on the retention of a so-called useful, but questionable tooth.

VI. SECURE TEMPORARY IMMOBILIZATION

Frequently the injured cannot receive adequate treatment of their jaw fractures at once. This is certainly the case in the combat zones. In civil practice also, a delay may be necessary because of other severe injuries or complications. In such instances, temporary reduction and immobilization of the fracture will decrease the danger of secondary hemorrhage and infection, relieve pain and shock, and prevent disfigurement.

If a sufficient number of teeth are present, horizontal wiring across the fracture gives good support, or the method described by Tigerstedt (supra) may be used. Intermaxillary fixation is not desirable as a first-aid measure, except by means of elastics attached to Kazanjian buttons (Fig. 39). Skeletal fixation, if available, may be applied under local anesthesia for simple primary reduction, and later when complete reduction is possible, may serve as a permanent fixation.

VII. CHOOSE THE CORRECT TYPE OF ANESTHESIA

The choice of anesthesia depends on many factors. Simple fractures without complications may be reduced under local anesthesia, a combination of conduction and infiltration methods. Local anesthesia should also be used in patients suffering from shock, or those who are in poor physical condition from other causes. General anesthesia, however, is more desirable when the surgical procedure is complicated by contusions and lacerations about the mouth, when muscular relaxation is desirable to reduce the fractures, and when multiple fractures are widely distributed. The physical and mental condition of the patient is important. Unstable, apprehensive patients should also be given a general anesthetic if possible. Other factors which must be considered are the duration of the operation, and the condition of the operative site. Intravenous anesthesia has many advantages in patients in good physical condition. Contraindications are shock, anemia, cyanosis, pulmonary disorders, and respiratory obstruction.

It has the advantage of quick induction, and is followed by a minimum of nausea and vomiting. Endotracheal administration of ether is probably the safest type of general anesthesia, and should be used if the intravenous administration of sodium pentothal is contraindicated. The endotracheal tube may be inserted through the nose, to administer the anesthetic or to prevent aspiration of mouth secretions. If intravenous anesthesia is used it is possible to pack the oropharynx completely around the tube. Preanesthetic sedation should be used in all cases. It frees the patient from apprehension and decreases the amount of anesthetic needed. For robust adults, a combination of nembutal (3 grains two hours before the operation), scopolamine ($\frac{1}{300}$ grain two hours before and repeated one hour before the operation), morphine ($\frac{1}{6}$ grain), and atropine ($\frac{1}{150}$ grain one hour before) produces sedation, reduces reflex irritability, and arrests salivation and mucous secretions.

VIII. GIVE ATTENTION TO PROPER REDUCTION

A great deal has been written about the apparatus and methods for the immobilization of fractures, and very little about methods of reduction. Fresh fractures generally are reduced easily by manipulation. It may be necessary to disimpact the fracture against muscle pull; in such cases general anesthesia is helpful because it causes muscular relaxation. In all, but especially in oblique fractures, distraction must be guarded against. It may be due to interposition of a splinter of bone, soft tissue, an organized blood clot, or a foreign body. The bones must be approximated properly. Good reduction can be achieved in many cases by intraoral and external manipulation, and by palpation of the surfaces of the bone. The position of the distal as well as of the proximal fragment, and the occlusion of the teeth must be carefully checked. The reduction is generally performed after the apparatus for fixation has been applied, and as a rule, it takes two operators to reduce and immobolize the jaw. In some cases open reduction should be resorted to in order to obtain accurate results; this is especially true of certain fractures of the mandibular condyle (Fig. 73), and in some fractures at the angle of the jaw (Fig. 66). The result of the reduction should be checked by x-ray examination.

Late reduction of fractures that are from one to two weeks old may still be accomplished by traction. Later, if strong fibrous or bony union has occurred with the fragment in malposition, corrective osteotomy is the only procedure that allows realignment. It can be performed in the mandible as well as in the upper jaw. Sometimes a sliding osteotomy is needed to lengthen the lower jaw if it has been shortened by loss of substance.

IX. SELECT THE BEST METHOD OF FIXATION

A well-considered decision must be made in the choice of the method of fixation. In single fractures this is not difficult, but in multiple mixed fractures a great deal of careful planning is required, and some combinations of fractures of the middle and lower parts of the face tax one's ingenuity. Each case must be decided upon its own merits, the magnitude of the injury, the availability of apparatus, the facilities for operative procedures, and the experience of the surgeon; all play a determining role. I favor the surgical approach; it eliminates many dental procedures which are time-consuming and expensive, often

delaying reduction for days, and which do not always bring about accurate results. The construction of splints requires a dental laboratory and technician, which are not easily available to the oral surgeon working in a hospital. In unusual cases, however, they may be absolutely necessary (comminuted fractures, bone grafting). A good general rule is to use the simplest method by which it is possible to accomplish adequate reduction and fixation. A better result often can be obtained when combining two methods such as intermaxillary fixation with skeletal fixation, and one should not hesitate to use all means available to obtain the best immobilization possible. The accessory appliance may be removed as soon as it is safe to do so.

In late fractures when the treatment has been delayed two weeks or more, and when muscular spasm or fibrous union prevents reduction by manipulation, skeletal traction must be used either by appliances fastened to the teeth, or by means of various types of external apparatus.

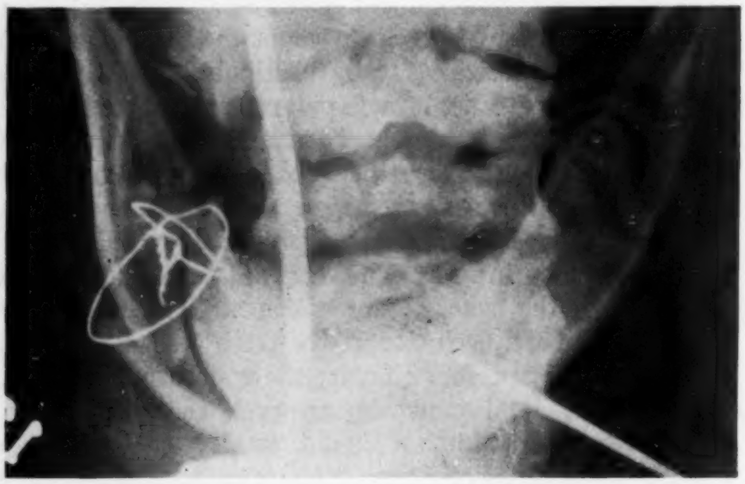


Fig. 62.—Comminuted fracture reduced by interosseous and circumferential wiring.

Interosseous wiring and circumferential wiring have been successfully used in my clinics. The use of stainless steel wire has given excellent results in fractures of the malar bone, orbit, maxilla, ramus, angle of the jaw, and body of the mandible. In comminuted mandibular fractures, circumferential wiring may be applied without a splint by making an intraoral incision to expose the bone, and closing the mucosa over the twisted wire. Interosseous wiring may be helpful in other cases. The wire suture may be applied by the intraoral or the external approach, and if the fracture is widely exposed, this method facilitates a more accurate reduction of fragments that are difficult to control otherwise. Interosseous wiring, however, seldom gives sufficient support to the bone, and the jaw should be immobilized. I feel strongly that the failures with this method are due to ineffective fixation. It should be used in combination with intermaxillary wiring or a Gunning splint. I generally remove the circumferential wires, but the interosseous wires may be left permanently unless they interfere with the wearing of a denture. The use of both circumferential and interosseous wiring is shown in Fig. 62.

Skeletal fixation, although not as yet out of the experimental stage, has already proved itself a great adjunct to the armamentarium available for fracture treatment. The Haynes-Griffin appliance, while having the advantage of great stability, presents certain difficulties in its application. The pins must be placed parallel to each other and at an unalterable distance apart, otherwise the blocks cannot be attached to them. Furthermore, the pairs of pins must be approximately in alignment, because the connecting rods allow only moderate disalignment. Bending them (Fig. 63) or replacing them by German silver wire (Fig. 54) facilitates the use of this appliance. The Frac-Sure appliance, on the other hand, is very adaptable. It can be used in any situation or in any combination. Pins may be inserted wherever they are most needed, and at an angle which will give the best support. When the pins are far apart, additional connecting rods can be applied to give the appliance greater stability (Fig. 64).

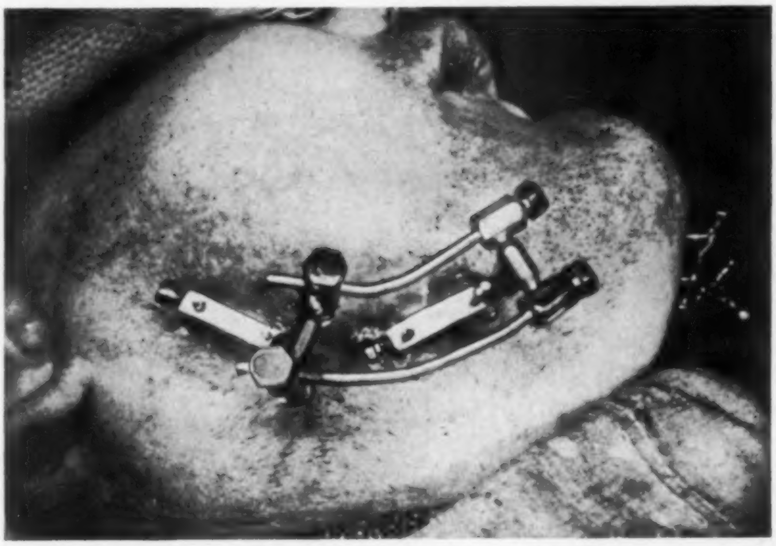


Fig. 63.—Griffin appliance with connecting bars bent for simple mandibular fracture of edentulous mandible.

The advantages of skeletal fixation already have been adequately described, and so has the technique of application. Some surgeons insert the pins by hand, either with a screw bit or with a hand drill. Ivy and Curtis (1943) pointed out that it was difficult to find the holes if a burr was used to drill them before inserting the pins. I prefer to drill a hole with an electric dental engine. It eliminates the pressure which otherwise must be applied to insert the pins, and which may cause displacement of the fragment. I use a spear-shaped drill to make the hole, and keep my fingers on the skin over the jaw while removing the drill and inserting the pin. Care must be taken, however, not to overheat the bone; the drill should be turned slowly, or cooled with water while it is being used, and a new drill should be used for each hole. Pins should not be inserted near infected bone, nor through an area involved by cellulitis.

After the pins are inserted, other surgical procedures that may be necessary, such as sequestectomy, extraction of teeth, removal of foreign bodies, excision of scar tissue, incision, and drainage, should be done. Next comes the reduction of the fracture by manipulation inside and outside of the mouth until the correct anatomic position has been achieved; then all connecting bars are attached and all nuts are very securely tightened. In addition, it is necessary to state that the appliance should not be used to manipulate the fragments; the reduction of the fracture should be accomplished by manipulation of the bone. In oblique fractures which tend to distraction, a circumferential wire may help to prevent lateral displacement. While one of the advantages of skeletal fixation is avoidance of intermaxillary fixation, the same apparatus may be used to immobilize the jaw; this is often necessary in fractures of the condyle or of the maxilla, and can be done by attaching the mandibular appliance to pins inserted into the malar bone (Fig. 64), or a pair of pins may be inserted into the mandible and attached to a plaster cap or headband (Fig. 75).

Fig. 64.—Frac-Sure appliance with two pairs of pins placed far apart in an almost edentulous mandible for treating an oblique fracture with osteomyelitis at the symphysis. A pin in each malar bone is used to immobilize the jaw for stabilizing a fracture of the condyle. Note formation of triangle by connecting bars, giving greater stability to the apparatus.

I believe that the hook screw attachment of Pohl (supra) or the Brenthurst clamp of Penn (supra) has many advantages over the pin fixation method. It would appear that at the angle of the jaw or at the posterior border of the ramus it might be particularly useful because of the thinness of the jaw in

this region, which often gives unsatisfactory attachment to the half pins. Any stress or strain, such as occurs when the patient turns in sleep on the splinted side of the face, has the tendency to loosen the pins.

The following outline for the treatment of various types of cases may be of value to the reader:

A. FRACTURES OF THE MANDIBLE

1. *Single or multiple fractures within the dental arch* are generally reducible by intermaxillary wiring by the Gilmer or the eyelet methods. In old fractures with displacement, elastic intermaxillary or interarch traction may be needed; the former is applied by means of the Jelenko (Fig. 65) or Winter arches, the latter according to Moorehead. If the fractures tend to displacement after reduction, interosseous wiring, or skeletal fixation may be a help. This method should also be used if immobilization of the jaw is undesirable or contraindicated.

Fig. 65.—Jelenko splint with traction applied to restore normal occlusion in a mandibular fracture associated with bilateral condylar fracture.

2. *Single or multiple fractures with an insufficient number of teeth for intermaxillary wiring* may be treated by intermaxillary ligation with Gilmer arch wires attached to anchor teeth with Angle bands (Fig. 16). More satisfactory results are obtainable by skeletal fixation, especially in cases of multiple fractures and fractures with displacement due to muscle pull, or if the teeth needed for anchorage are questionable or actually involved in the fracture and therefore are to be removed.

3. *Single or multiple fractures with one fragment edentulous.* These fractures are very common; generally the edentulous fragment consists of the vertical ramus with more or less of the horizontal ramus attached to it. The horizontal part may contain an involved tooth which has to be extracted. In

these cases a splint with an extension arm (especially useful in children), a wire looped through a hole drilled into the angle of the jaw and connected to a bar extended from a head cap, are used by many. They are not foolproof because adjustment is difficult, and they often become disarranged. Posterior, medial, and external displacement cannot easily be controlled. Skeletal fixation gives good results, although the vertical ramus being very thin near the angle does not give as good an attachment as the horizontal ramus of the mandible. The use of skeletal fixation in bilateral fractures at the angle is inadvisable, because difficulty in positioning the head when sleeping is apt to cause displacement. I prefer internal wire fixation by means of an open operation (Fig. 66), as the result is much more accurate than that gained by any other method. I consider the danger of necrosis from the drill holes,

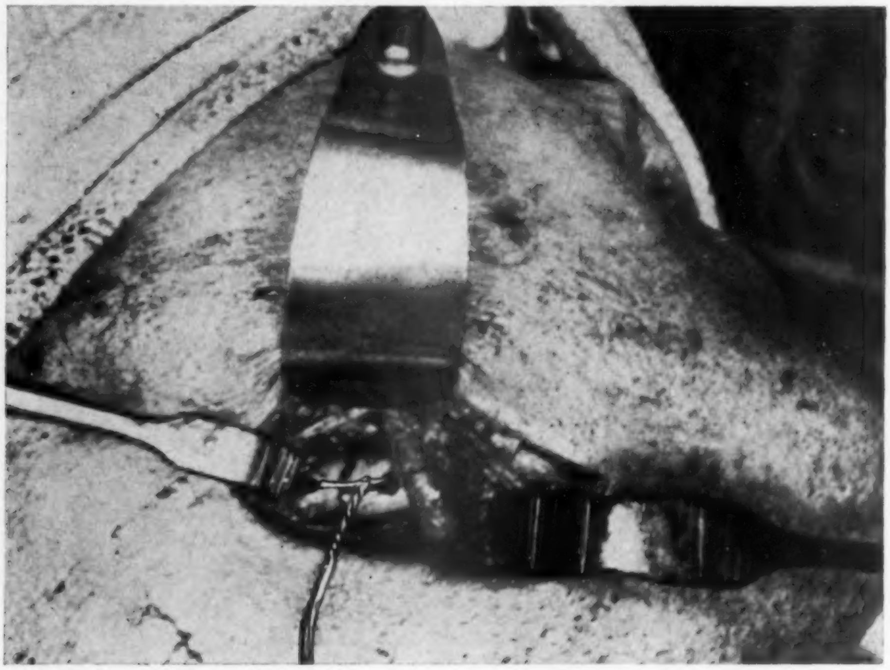


Fig. 66.—Direct wiring with open reduction.

if it should occur, of little consequence; it is not more serious than that which occurs if a drill hole is made to attach a traction wire. Intraoral direct wiring may be advisable in some instances, such as cases with cellulitis and submandibular infection. This method may also serve in comminuted fractures (Fig. 62), but according to my observation, the results obtained are not as accurate as those secured by the cutaneous approach, especially in oblique fractures with the tendency toward displacement (Fig. 68). The use of intraosseous wires (Kirschner wires, Steinmann pins) I consider dangerous in compound fractures, as they are inserted through the fracture line and may carry infection into the adjacent bone.

4. *Simple or multiple fractures in edentulous jaws,* when within the coverage of an artificial denture, may be reduced and stabilized by placing circum-

ferential wires around the jaw and over the inserted denture. If no denture is available, a simple splint fitting over the alveolar ridge may be made from an adjusted impression. The wires (stainless steel) are placed on each side of the fracture and are easily introduced by means of a long, curved, 14 gauge hypodermic needle (Fig. 67). Sometimes in single, lateral fractures, a wire must be placed on the opposite side to balance the denture. Accurate reduction of edentulous mandibles without the use of an intraoral splint is not easy.

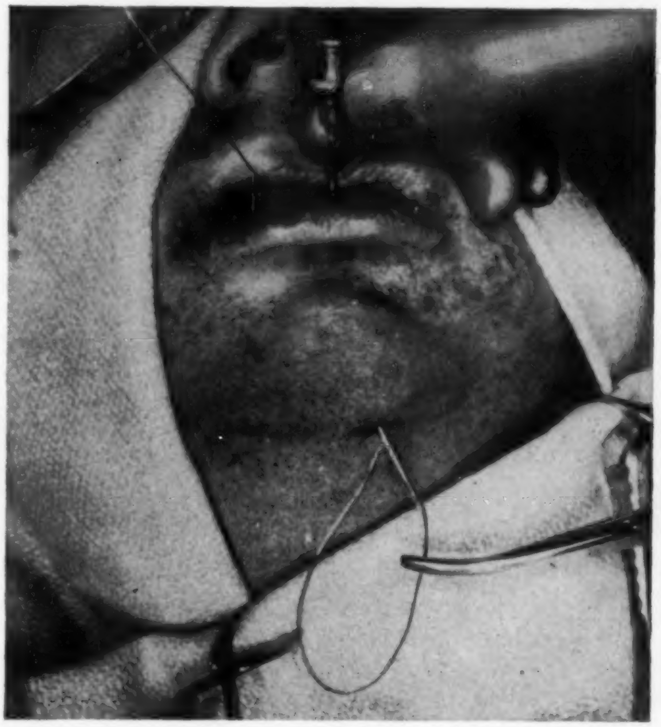


Fig. 67.—Introduction of circumferential wire through hypodermic needle.

Skeletal fixation is very useful, especially in cases in which the reduction accomplished solid impaction of the fragments. In oblique fractures, particularly those in atrophic mandibles of older patients, the patient's denture should be used for a time as an intraoral splint in addition to external pin fixation or direct wiring; it may be held in place by a bandage. In mandibles with alveolar atrophy, direct wiring should be undertaken only from an extraoral approach. Intraoral wiring in fractures of the horizontal ramus often causes injury to the mandibular nerve and does not prevent displacement (Fig. 68). Displacement is very important from the neurological point of view, although it may not be important from the point of view of mastication since new artificial dentures correct all but unusual deformities. If the mandibular canal is displaced at the fracture site (Fig. 68), we not only get permanent anesthesia of the lip and chin, but also, in many cases, paresthesia which causes much suffering and is frequently due to a neurinoma developing in the end of the central part of the nerve. The use of intraosseous fixation by means of Steinmann pins may give good results in fractures that are not compounded

either into the mouth or to the outside of the face, if the pin can be successfully guided, as described by Pincock. I do not think, however, that the method should be used if the x-ray findings indicate that the mandibular nerve may be accidentally injured by the procedure.

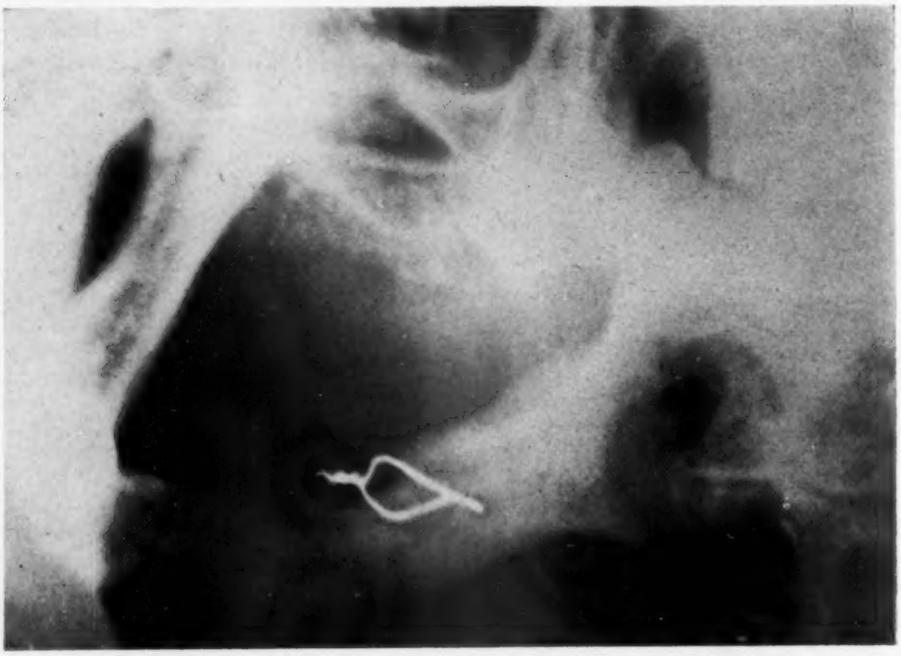


Fig. 68.—X-ray showing intraoral transosseous wiring with poor alignment resulting in permanent anesthesia and paresthesia in the parts supplied. Removal of the wire and nerve repair brought prompt relief. Note termination of mandibular canal over alveolar ridge.

5. *Comminuted fractures of the jaw* present so great a variety of problems that no simple rules can be laid down regarding their treatment, except that one should always attempt to save all fragments of bone unless they are completely detached, or are about to be sequestrated. The already reported more radical procedure of Cuthbert should be given consideration, especially in septic cases. Open extraoral reduction and direct wiring in general have been condemned by everyone. However, as pointed out (supra), Gordon (1943) made a plea for using wire sutures again, since today the availability of stainless steel gives us a noncorrosive, nonirritating metal from which better results may be expected. This has been borne out in my experience with tantalum and stainless steel wire, but it should again be stressed that all wired mandibles should be immobilized by some form of intermaxillary fixation, such as wiring, a Gunning splint, or skeletal fixation, because I feel that many failures in the past have resulted from ineffective immobilization rather than from the method per se. Skeletal fixation may aid greatly in some comminuted fractures, although in war injuries Kazanjian's method of fixation to a bar splint (Fig. 28) has given excellent results.

In order to fix large detached fragments of the alveolar process or of the inferior border, circumferential wiring has been found very useful; I often resort to it without the use of a splint over the alveolar ridge, applying the

wire subgingivally (Fig. 69). The combination of transosseous wiring at the alveolar ridge with circumferential wiring around the inferior border of the jaw, has a great deal to recommend it, and has the advantage of easy application. The wire is inserted through a hole drilled in the base of the alveolar process, and is drawn down vertically over the lingual surface and through the skin by means of a hypodermic needle; from here it is passed obliquely over the fracture line along the anterior surface by the same method. When both wires are introduced the fracture is reduced and the wires twisted, as shown in Fig. 70, *A*. The short intraoral incision to prepare a buccal and lingual flap is closed over the wires with silk. In oblique fractures a single suture may be sufficient, especially if the mandible is immobilized (Fig. 70, *B*).

Fig. 69.—Circumferential wire holding alveolar fragment in position.

A. B.

Fig. 70.—Combination of transosseous and circumferential wiring. *A*, In horizontal ramus; *B*, at angle of jaw.

6. *Malunited fractures of the mandible* often are associated with considerable physical and mental suffering. Their treatment, which cannot be included in this paper, involves a combination of osteotomy and bone grafting. Neurological complaints can often be relieved by nerve repair as described by Thoma (1944).

7. ***Fractures of the mandibular condyle*** are not to be considered unimportant. I know that the result of the present treatment is not as satisfactory as many who have written on this subject believe it to be. The minimum conservative treatment should be as follows:

Two weeks of intermaxillary traction in the incisor region with an occlusal block from 2 to 4 mm. wide interposed between the last teeth (Fig. 71) to overcorrect the open-bite, and three additional weeks of intermaxillary fixation without the block. In most cases, this gives a fair result which is dependent on the amount of displacement of the neck of the condyle and the character of dislocation of the joint, if present. The method has been advocated to correct the overriding of the condyle, but it is actually based on a wrong assumption, namely, that the ramus can be drawn down to overcome the displacement. Walker (1942) stated that this method produced no consequent reduction in the overlapping of the fragments, and experiments which I have conducted for several months led to the same conclusion. Two factors tend to prevent this taking place; first, the stylomandibular and sphenomandibular ligaments limit the down movement of the ramus to a very small distance, while second, the capsule of the mandibular joint allows the condyle,

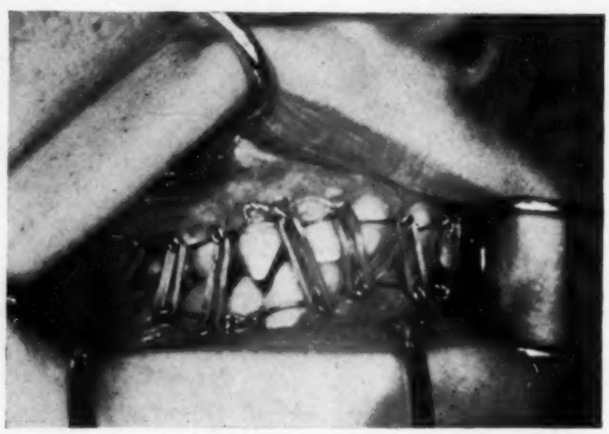


Fig. 71.—Intermaxillary traction with Stout's continuous wire loops, and occlusal block to overcorrect open-bite in condylar fractures.

which generally is attached to the ramus by periosteum, to be drawn down so that nothing is accomplished. In the treatment of badly displaced or dislocated condyles, one should make an effort to draw the condyle up into the glenoid cavity and hold it there while the rest of the mandible is put into correct position by intermaxillary wiring or traction. This sometimes can be accomplished by inserting a pin into the neck of the condyle, which in turn is attached to a rod extending from a head gear by means of a Frac-Sure bar (Fig. 72). The pin also serves to manipulate the condyle so as to correct the forward, medial, external, or posterior displacement. If possible, the condyle should be impacted against the ramus before intermaxillary ligation is applied. However, if good contact can be established between the fragments and maintained, these fractures generally heal well by this method. Open reduction, however, gives the best results, although this method requires experience and familiarity with the field of operation.

When using the open method the fracture may be reduced by inserting a lever (I find a small bone file, serrated on one side and smooth on the other, an ideal instrument for this purpose) between the fragments, and fixed by means of a 25 gauge stainless steel wire inserted through oblique holes drilled from the outer surface to the center of the fracture surface, as described in my monograph (Thoma, 1942), and illustrated in Fig. 73. The wire is left permanently (Fig. 74).

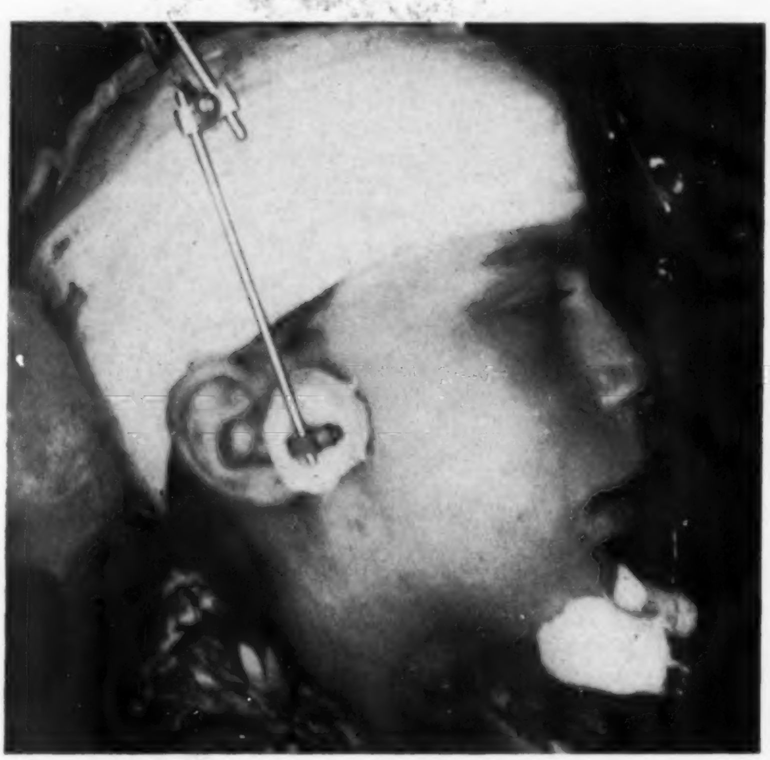


Fig. 72.—Condylar fracture reduced and immobilized by means of pin inserted into condyle and attached to plaster cap. External traction from head cap to chin.

In fracture dislocations when the condyle shows tendencies to slip out of the glenoid fossa, a pin is inserted into the condyle while it is held with forceps. The pin is then attached to the head cap (Fig. 75), or to a second pin inserted into the eminentia articularis which prevents it from slipping out again (Fig. 76). The operation is performed under pentothal sodium intravenous anesthesia, and the intermaxillary fixation is accomplished by elastics attached to Jelenko splints, so that in case of emergency the mouth can be opened easily.

The use of a half pin in the condyle seems to be simpler though not so good as direct wiring, but the latter method is sometimes difficult, especially when the fracture is found in the subcondylar area of the ramus.

Condylar fractures in patients with edentulous jaws require special methods for immobilization. A Gunning splint can be made, or the dentures may be used to improvise one. A bandage may be applied to hold the mandible

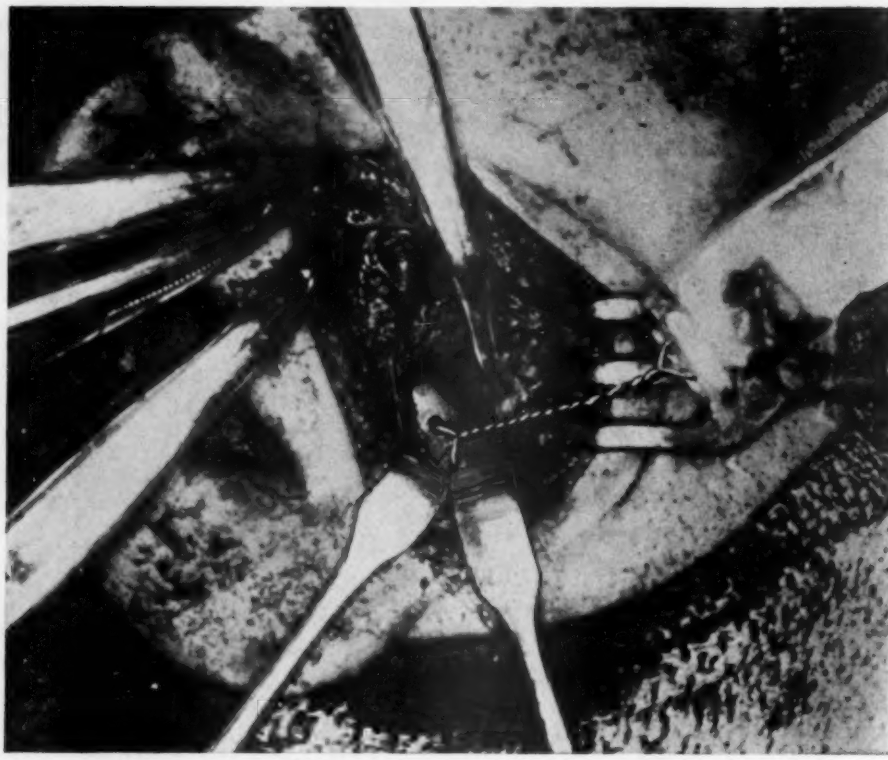
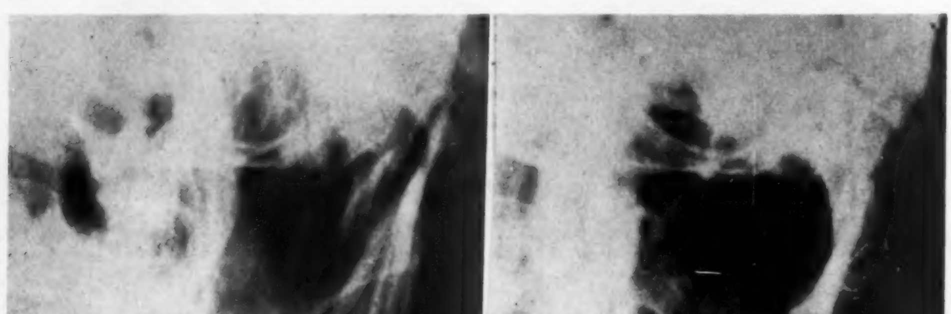


Fig. 73.—Open reduction with internal wiring fixation of condylar fracture. Tightening of wire with wire twister.



A. B.

Fig. 74.—X-ray of condylar fracture. *A*, Before, and *B*, after reduction.

Fig. 75.—Immobilization of edentulous mandible in multiple fractures (comminuted fracture of horizontal ramus on one side, fracture and dislocation of condyle and fracture of coronoid process on the other side, also fracture of the maxilla) by means of half pins inserted into the anterior part of the mandible and attached to rods from a headband. Note extension rod to pin in condyle. Third week after operation.

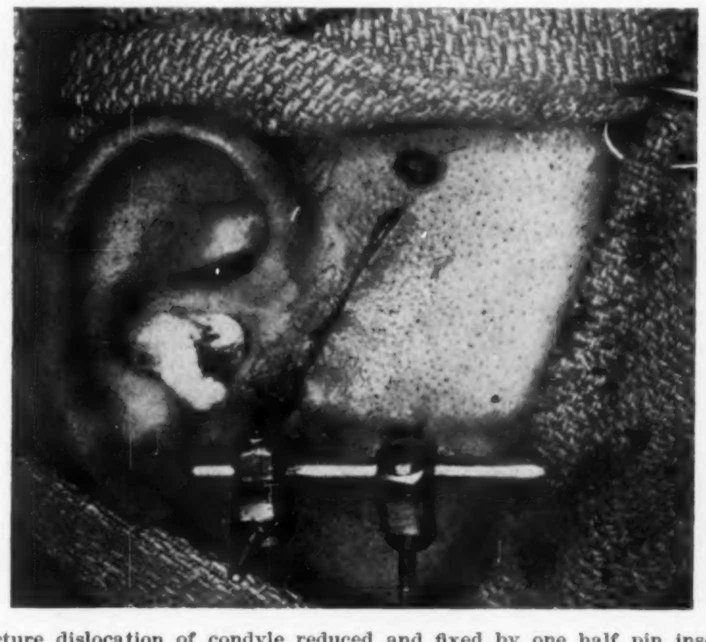


Fig. 76.—Fracture dislocation of condyle reduced and fixed by one half pin inserted into the condyle, and another into the eminentia articularis, and fixed by a connecting bar.

in position against the splint or dentures. This form of stabilization is not always effective and a bandage is sometimes contraindicated when other major fractures involve the horizontal ramus. Waldron's use of a Kirschner wire through the chin, attached to a headband, may be applicable, with or without dentures. In patients with a maxillary denture only, my method (Thoma, 1943) of fixation by passing stainless steel wires through the margin of the piriform nasal aperture and over the inserted denture to an arch wire attached to the mandibular incisors may be used (Fig. 47), or these wires may be attached to circumferential wires in the canine region passed around the mandible carrying a lower denture. Another method accomplishing the same thing consists in placing a half pin into the mandible, on each side of the chin if possible, and fastening it to the head gear (Fig. 75). Inserting half pins into the malar bones and connecting them to a skeletal appliance attached to the mandible may also serve a similar purpose (Fig. 64). The last two methods will not only prevent the patient from moving the jaw, but will accomplish immobilization without the use of a denture splint, so that wounds in the mouth are freely accessible. Also, there is no interference in drinking a liquid diet, nor in the case of vomiting.

B. FRACTURES OF THE MIDDLE THIRD OF THE FACE

Fractures of the middle third of the face are generally much more serious than mandibular fractures, especially when associated with concussion, brain laceration, and/or fracture through the base of the skull. With cerebrospinal rhinorrhea or otorrhea and hemorrhage, manipulation of the facial bones should not be undertaken until it is safe. In such injuries, therefore, treatment is often delayed until reduction by manipulation is no longer possible. Reduction is frequently delayed unnecessarily, however, because of lack of cooperation between various departments in a hospital. Blindness and paralysis due to impingement on motor nerves often disappear miraculously if the displaced fractures are successfully reduced, while fibrous union may prevent this accomplishment if reduction is delayed too long.

1. *Horizontal fractures of the maxilla through the maxillary sinuses* (Fig. 77, *A*), and simple fractures of the maxillary alveolus are generally reduced easily by intermaxillary ligation, or in late cases, by traction to bring the backward displaced maxilla into normal occlusal relationship. A Barton bandage with elastic reinforcement or its equivalent should, in addition, be applied around the head. If the walls of the sinus are comminuted, the sinus should be opened through the canine fossa, entirely detached pieces of bone removed, and other pieces pressed into position and held with a strip of boric gauze placed into the cavity but allowed to extend through the incision for easy removal. An improvised Kingsley splint attached to a headband may be used if intermaxillary fixation is not practical (Fig. 37).

2. *Pyramidal fractures* (Fig. 77, *B*) involve, in addition to the maxilla, the nasal and ethmoid bones, and often the vomer and nasal septum. The cribiform plate may be fractured, allowing cerebrospinal fluid to run from the anterior cranial fossa out through the nose. Patients with this sign have a poor prognosis, and should not be carelessly manipulated.

3. *Transverse fractures of the face* (Fig. 77, *C*) involve the malar as well as the nasal bones. The entire middle part of the face may be pushed back as much as ½ inch, which causes not only a dish-shaped face, but also hemorrhages into the palate, pharynx, antra, and conjunctiva, and impingement on important nerves (optic, and motor nerves of the eye), as well as diplopia through disarrangement of the floor of the orbit due to comminution of the maxilla. The orbital margin may be disaligned because of fracture of the processes of the malar bone and of the maxilla. This is generally associated with marked swelling of the eyelids and ecchymosis (Fig. 60).

A. *B.* *C.*

Fig. 77.—Three types of middle-third face fractures. *A*, Horizontal fracture of maxilla; *B*, pyramidal fracture; and *C*, transverse fracture of face combined with horizontal fracture of the upper jaw.

Early and accurate reduction of transverse fractures of the face is very important for the elimination of the complications enumerated, and to restore facial appearance. It should be undertaken as soon as complications permit. If all or most of the teeth are present, and there is no horizontal fracture of the maxilla, establishment of the correct interdental relationship may accomplish reduction of the facial fracture. Intermaxillary traction may be needed or external traction may have to be applied either with an arch wire attached to the maxilla, or by means of eye screws inserted into the displaced malar bones, the traction being applied from rods extending from a head cap or band. The infraorbital margin, if displaced, should be held in position with a wire looped around it and attached to another rod from the head appliance. The lateral wall of the orbit may be repaired by means of wire sutures (Fig. 78). The walls of the maxillary sinus should be decompressed and held in place by an antral pack.

In combinations of the three types of fractures of the middle third of the face, the intraoral horizontally detached fragment of the maxilla may have to be fixed to the superstructure by means of a winged reversed Kingsley splint or a Gunning splint. In partially or completely edentulous maxillas, a Steinmann pin, placed transversely through the face above the reflection of the mucosa, as recommended by Brown and McDowell (supra) may give good

results. I think half pins inserted through the cheeks on each side as far as the hard palate are better, because if one has to be removed for any reason, the other will hold. Bars are used from a head cap to complete the fixation (Fig. 79).

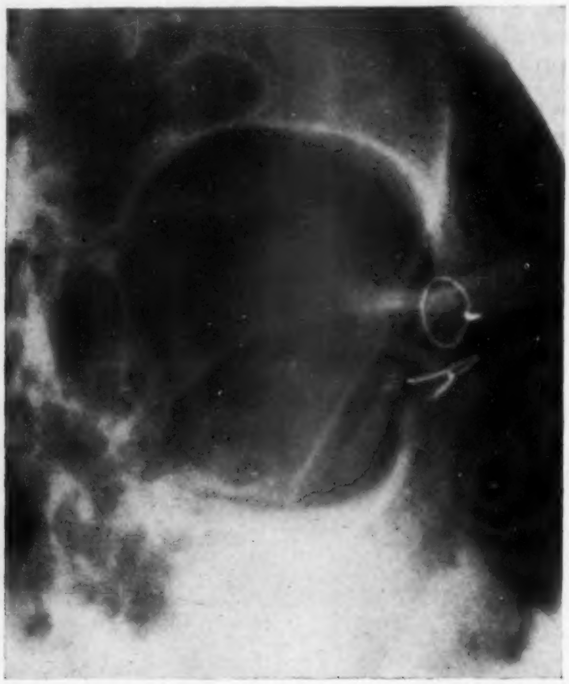


Fig. 78.—Fracture of orbit repaired by means of wire sutures.

Internal wiring, as recommended by Adams (supra), brings us a great step forward in the treatment of these cases, as it eliminates the cumbersome Kingsley splint and the easily dislodged head gear so often the cause of pressure sores. With this method the maxillary intraoral fragment is held in contact with the superstructures by means of the wires looped through the supraorbital ridges (Fig. 80) or infraorbital margins. The wires from the supraorbital ridges passed behind the malar bone may also be used to bring the entire middle-face fragment forward either by pull when reducing the fracture, or gradually by means of elastic traction. In such cases the supraorbital wire is attached to the arch band applied to the mandibular teeth and is tightened every day until the reduction is completed (Fig. 81). If infraorbital wires are used, they may be attached to an arch bar fixed to the upper teeth, and intermaxillary fixation is not needed unless maloeclusion exists and has to be corrected. In order to remove the internal wire loops easily, guide wires may be attached to one strand and allowed to project through the incision. These make it easy to locate the subcutaneous wire in order to cut it and withdraw it through the mouth.

Wires may also be looped through the bony margin of the piriform aperture of the nose, and brought down to an arch wire attached to the fractured alveolar segment of the maxilla. This method is especially useful for immobilization of the anterior part of the maxilla fractured below the nasal aper-

ture. The stainless steel wire may be carried below the mucosa to prevent cutting into it, or over the mucosa if the wire does not injure the gingiva (Fig. 82).

C. MIXED FRACTURES

Multiple mixed fractures involving the middle third of the face, as well as the mandible, have, in the past, presented difficult problems in treatment, because in most of the established methods the solid opposite jaw has been used as a splint to stabilize the bone; but if both jaws are broken, there is no stability in either part.

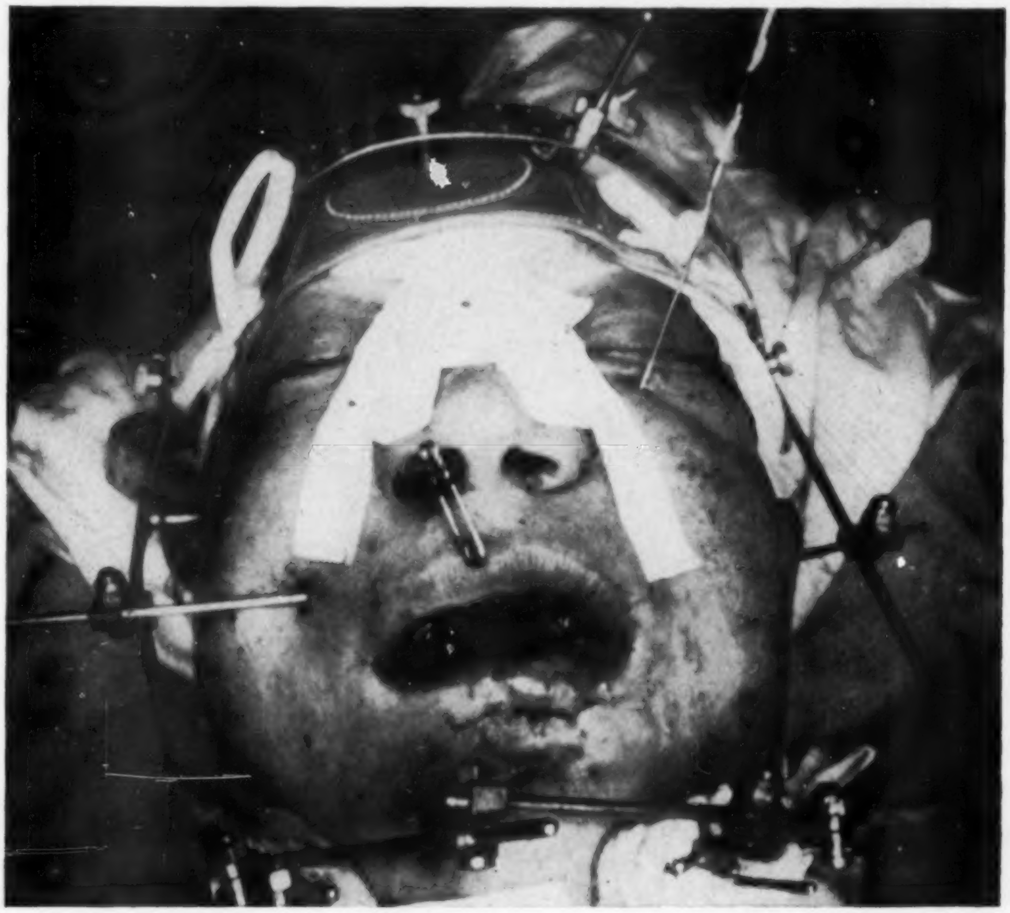


Fig. 79.—Patient shown in Fig. 60 after reduction of fractures under intravenous anesthesia. Horizontal maxillary fracture reduced with half pins inserted into the practically edentulous upper jaw to hold it in apposition with superstructure by means of rods extended from a Woodard headband. Mandibular fracture reduced with Frac-Sure appliance. Transverse facial fracture with malar bone and maxilla comminuted on left, and pyramidal fracture involving nasal bones, ethmoid, and piriform plate reduced by internal wiring. Note wire holding infraorbital margin in reduced position from rod attached to headband.

In such fractures of the face, therefore, a complete and careful survey must be made, and a decision arrived at, as to the methods to be used, and the order in which to proceed. If teeth are present, the intermaxillary relation adds to the problem of reducing the superstructures and understructures properly. With the use of skeletal fixation, transfixation with Kirschner wires, Steinmann pins, and internal wiring methods, the problem becomes easier

Fig. 80.—Internal wiring for middle third face fracture. Probe inserted to pass stainless steel wire looped through supraorbital ridge into oral cavity behind malar bone.

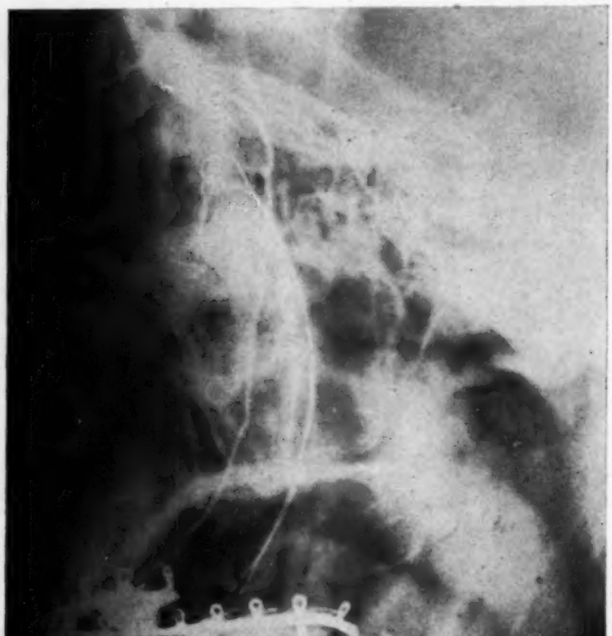


Fig. 81.—Internal wiring (patient shown in Fig. 80). Note wires extending behind malar bones into mouth where they are attached to Jelenko arch, and also the guide wires to facilitate removal of internal wires.

because these newer methods make it possible to fix the mandible independently so as to use it as a foundation upon which to assemble the upper jaw; this, in turn, can be brought into proper relation with the adjoining parts by means of wire sutures. All of this is not necessarily accomplished at a single operation. Two or more procedures may be required for the complete result. A patient showing a combination of various reduction methods is shown in Fig. 79.

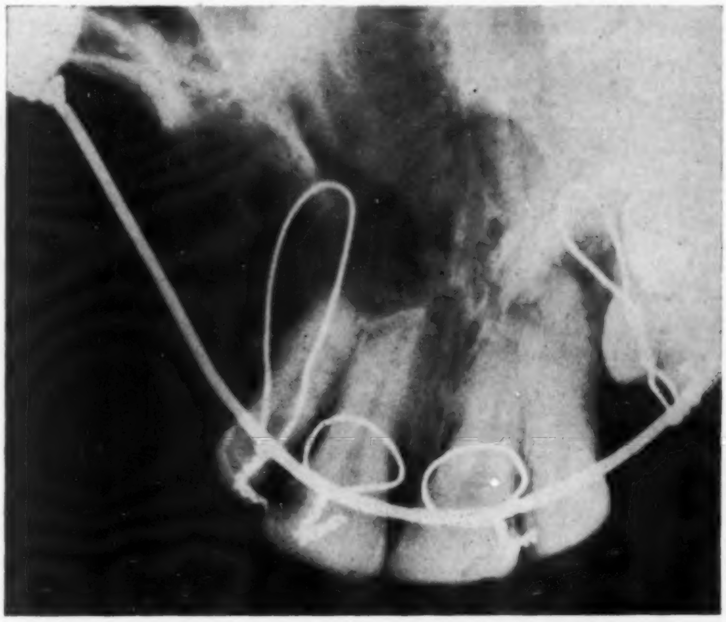


Fig. 82.—Internal wiring fixation in case of fracture of the anterior alveolar segment of the maxilla. Wire loops are passed through the margin of the piriform aperture of the nose.

X. GIVE PROPER ATTENTION TO AFTERCARE

The postreduction care is of great importance. Bed rest is needed in all cases, and after long operative procedures, dehydration must be counteracted by the intravenous administration of saline solution or plasma. Measures should be taken to alleviate pain and discomfort. Malunion and nonunion may result if the fixation is disturbed, if infection sets in, or if the general health of the patient fails. Postoperative roentgenograms should be taken to check the reduction and the process of healing. In all compound fractures, or in cases in which infection of the soft tissue or bone has already occurred, chemotherapy or biotherapy should be used and checked by determination of the blood level obtained. The temperature chart and the white blood cell count should be carefully watched. If abscesses develop, they should be promptly incised and drained, and wounds and dressings must be carefully attended to. A blood count should be taken, anemia treated if present, and the diet controlled, especially with regard to vitamins and calories. The weight of the patient should be maintained. Blood transfusions when indicated are very helpful. Vitamin C deficiency must be guarded against; if there is any indication of it, ascorbic acid should be prescribed in amounts of from 200-500 mg.

per day. The hygiene of the mouth must be attended to with care, by spraying and rinsing, and small dressings should be placed around the pins in skeletal fixation (Fig. 83). Good general nursing is of extreme importance. When finally the apparatus can be removed, it may be wise to restrain the movement of the jaw for a week or ten days by applying one or two intermaxillary elastics on each side. After having been completely immobilized, the jaw may have become stiff as a result of muscle spasm; in this case exercises and massage should be ordered. Bandages are used only as an accessory aid in holding dressings and in preventing opening of the jaw. They must be carefully applied so as to do no harm by displacing the fragments.

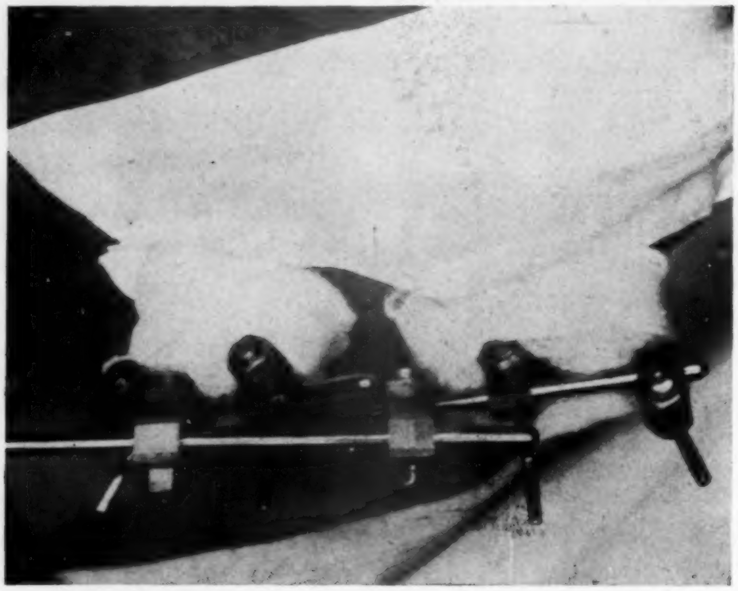


Fig. 83.—Dressings are applied around each pair of half pins, and over the incision which was made to drain a septic fracture.

SUMMARY

A review of the treatment of mandibular and middle third face fractures in periods of war and peace has been presented from the time of the ancient Egyptians, 3000 B.C., to the present. In the conclusion, ten commandments for the modern treatment of single, multiple, and comminuted fractures, as well as mixed fractures distributed over the entire facial skeleton has been given. The use of Kirschner wires or Steinmann pins has been indicated; application of the internal wiring methods has been described; and the use of mechanical skeletal fixation has been outlined. These newer methods should be looked upon as aids in solving the many difficult problems that constantly present themselves; however, they should be used only in cases in which simple, more conservative methods are likely to be inadequate. It should be understood that success with these methods depends not only on the experience, but also on the skill and judgment of the surgeon who uses them. All these newer methods are still in the stage of development, and improvements and new applications may be expected.

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FORM, LOCATION, AND CLASSIFICATION OF SUBGINGIVAL CALCULUS

JOHN H. GREENE, D.D.S.*

THE complete removal of subgingival calculus is generally considered the first "must" in successful periodontal treatment, yet this operation presents to many dentists serious obstacles. One of the difficulties experienced in the effective removal of subgingival calculus is the lack of appreciation of the anatomic relationship of the periodontal pocket to the deposits and lack of an effective technique rather than innate difficulty of operation.

A macroscopic study of the periodontal pocket was undertaken to determine this relationship in the hope of evolving an effective means of instrumentation based thereupon. Such a technique should permit complete removal of all deposits with the least possible damage to the tissues involved. Sealing would then become a precise operation.

The dental literature is replete with references on the chemical composition and the formation of calculus but it records only occasional mention of the form of subgingival calculus. Burchard[1] described five classes of calculus: (1) The yellowish-white deposits upon the buccal surfaces of the upper molars, (2) the calculi found on the lower anterior teeth opposite the salivary ducts, (3) the dark, flattened, hard, scalelike calculi found immediately beneath the gingival margins, (4) the small nodular calculi found deep in the pocket formation, and (5) that class found upon roots in cases of gouty necrosis of the pericementum (calculi of pyogenesis). This classification, which is based on the morphologic characteristics and chemical analysis of the calculus, has been disproved by later investigators.

Burchard made a distinct contribution to this problem which is not generally recognized. He noted that "There is always a space between the pericementum and calculus, showing that detachment or loss of pericementum is in advance of the calculus." Kirk[2] recognized two types of calculus: (1) the nodular or granular variety, and (2) the dense, thin, and smooth type. This differentiation is made by tactile sense with an instrument. Frequently, the tartar is smoothed and polished by the operator, who thinks it is cementum.

ORIGINAL STUDY

The form of the calculus, its location and relation to the crown and the ligamental attachment were studied in detail. This study was made on un-

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selected extracted teeth which were obtained from the extraction clinic of the Dental School, University of Pennsylvania, and cadaver jaws furnished by the Department of Anatomy of the Medical School, University of Pennsylvania. The specimens were kept in 40 per cent ethyl alcohol until the time of examination.

The moist teeth were identified and examined under a binocular dissecting microscope with a magnification of 10. The tooth was placed upon a piece of millimeter-ruled graph paper, which permitted accurate measurements of the structures under consideration. The following data were recorded for each tooth: (1) the tooth surface examined, (2) the type of calculus, (3) the extent of the calculus including line angle involvement, and (4) the distance in millimeters between the ligamental attachment and the apical margin of the calculus (Fig. 1). This latter measurement will be referred to throughout the paper as the subcalcular space.

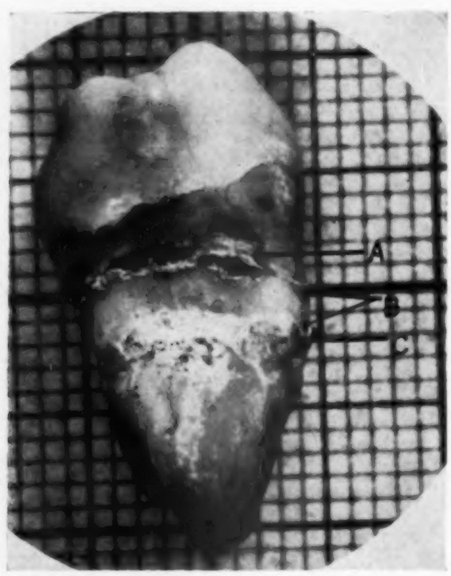

Fig. 1.—Mesial surface of lower second molar showing: *A*, subgingival calculus; *B*, subcalcular space or crevice; *C*, ligamental attachment.

Figs. 1, 2, 3, and 11 are photomicrographs by Wardlow M. Hammond, Research Associate in Microscopy, School of Dentistry, University of Pennsylvania.

A previous study employing the methods just described showed that subgingival calculus could be placed in one of three groups according to its morphologic characteristics: (1) the ledge type (Fig. 2), (2) the crustaceous type, and (3) the veneer type (Fig. 3).

The ledge type is most common. It is grayish in color, pumicelike in appearance and has a tendency to form a narrow shelflike structure around the roots of the tooth. The crustaceous type which occurs next in frequency, is usually found apically to the ledge variety, appearing to be a continuation apically of the ledge type. The crustaceous calculus is gray and has an appearance like an oyster shell. The veeneer form of calculus is least common. It is usually found unassociated with the previously described types. It is gray to black

and has a smooth appearance. When more than one type of calculus was apparent, which was frequently the case with the ledge and crustaceous forms, it was classified according to the predominating type.

TYPES OF CALCULUS AND SUBCALCULAR SPACE MEASUREMENTS

An initial analysis of the data was made when 200 teeth, fifty each of incisors, canines, premolars, and molars were studied. This preliminary analysis was made because of the similarity of certain of the data, particularly the measurement of the subcalcular space. It was felt that the results of this preliminary analysis might indicate the advisability of certain omissions or additions to the original plan of study. The relative frequency of the different (morphologic) types of calculus and of the subcalcular space measurements in the various tooth groupings is given in Fig. 4.

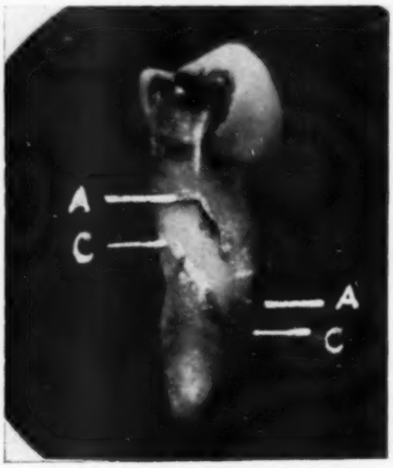

Fig. 2.

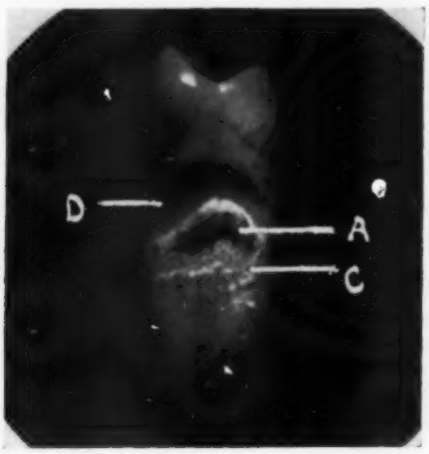

Fig. 3.

Fig. 2.—Lower first premolar, mesial surface. *A*, Simple ledge type calculus; *C*, ligamental attachment. Between *A* and *C* is the subcacular space or crevice.

Fig. 3.—Lower second premolar, mesial surface. *A*, Crustaceous type calculus; *C*, ligamental attachment; *D*, veneer type calculus. The ledge has been removed by instrumentation leaving a polished calcular veneer remaining upon the root.

On the molar teeth the ledge type of calculus is found almost twice as frequently as the crustaceous type. On the premolar teeth there is about an equal distribution between the ledge and crustaceous forms, while in the canines there is a slight increase of the crustaceous over the ledge type. In the incisor region the crustaceous type of calculus predominates almost 2:1 over the ledge form. This is the exact reversal of the findings on the molars. The few examples of the veneer type of calculus did not permit analysis according to the different tooth groups. A possible explanation for the infrequency of the veneer types of calculus will be brought out in the discussion.

EXTENT OF CALCULUS

The ledge type of calculus was observed as a narrow ledge encircling the root of the tooth. It resembled a miniature mountain range about the tooth,

with its peaks and its valleys. Occasionally ledge forms were seen in which there was an abrupt termination of the slope on the apical side of the calcular ledge. The ledge form occupied a relatively small proportion of the space between the enamel-cemental junction and the ligamental attachment. The width of the tartar ledge of the teeth studied did not exceed 3 mm.

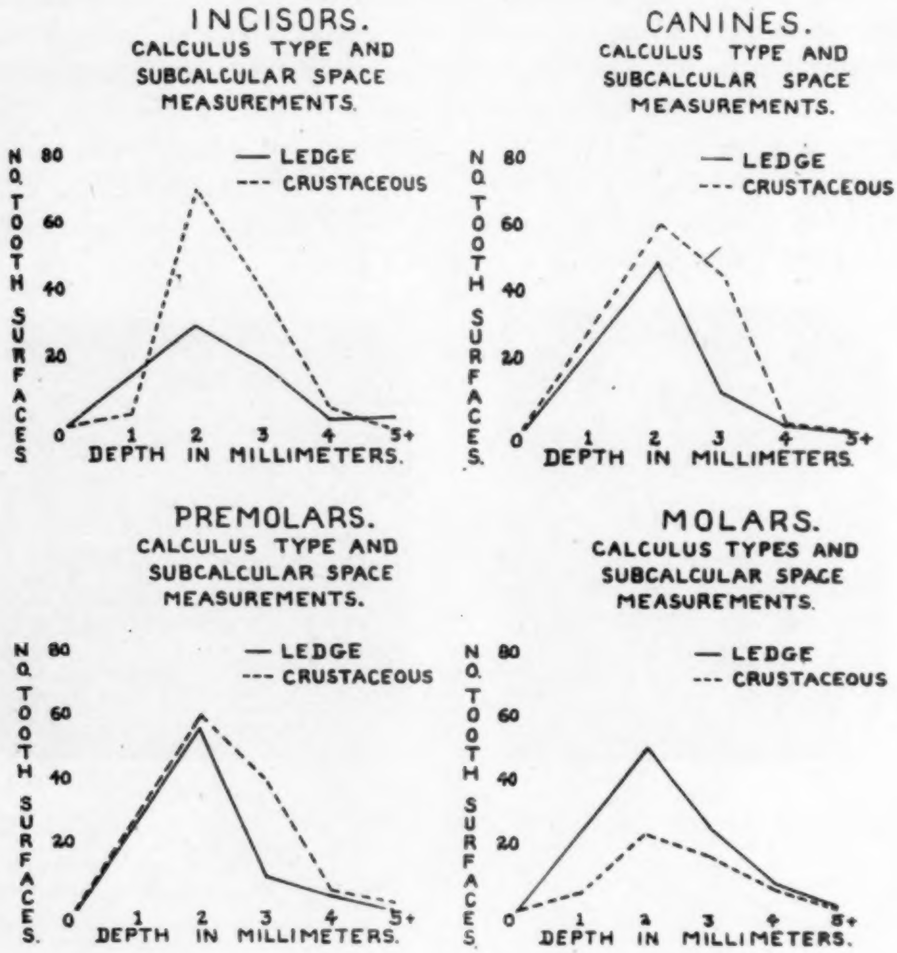

Fig. 4.

The crustaceous type of calculus was found commonly in conjunction with the ledge form. It appeared as a low plateau extending in many instances both apically and coronally from the ledge. The crustaceous form was found most frequently on the apical side of the ledge. It has a rough surface similar to an oyster shell. The crustaceous form of calculus occupied a larger area of the root surface between the enamel-cemental junction and the ligamental attachment.

The veneer type of calculus was rare. It appeared as a thin smooth glassy surface. In the specimens observed, this form was not usually associated with the other types. Fig. 3, however, gives a clear example of the veneer in combination with the crustaceous type.

LINE ANGLE INVOLVEMENT

It was noted whether the tartar mass extended across the line angle from one surface of the root to another. This was studied because of the common clinical impression that calculus is a surface coverage rather than a circumferential coverage. The calculus was observed to be continuous across 96 of the molar line angles, 90 of the premolar line angles, 86 of the canine line angles, and 108 of the incisor line angles. This represented 48 per cent of the molar line angles, 45 per cent of the premolar line angles, 43 per cent of the canine line angles, and 54 per cent of the incisor line angles. These data and the respective line angles involved are given in Table I.

TABLE I

PERCENTAGE OF TEETH WITH CALCULUS CROSSING THE LINE ANGLE FROM ONE SURFACE TO ANOTHER

	NUMBER OF TEETH				
	MESIOBUCCAL	MESIOLINGUAL	DISTOLINGUAL	DISTOBUCCAL	TOTAL (%)
MOLARS	28	20	20	32	48
PREMOLARS	18	30	24	18	45
CANINES	20	30	18	18	43
INCISORS	26	32	26	24	54

SUBCALCULAR SPACE

The subcalcular space represents the hard tissue wall of the gingival crevice below the calcareous deposit—the subcalcular crevice. The subcalcular area appears as a clear polished space of cementum with no fibrous attachments or calcareous deposits on the surface. The subcalcular space measurement is taken from the lowest tartar mass to the ligamental attachment on each tooth surface. It varies in depth from 1 mm. to 10 mm.

In Table II the frequency of the different calculus types on the tooth surfaces of the various tooth groupings is shown. There is little variation in frequency of a particular calculus type on the different tooth surfaces of a particular tooth group.

TABLE II

FREQUENCY OF TARTAR TYPES ON DIFFERENT TOOTH SURFACES IN THE VARIOUS TOOTH GROUPINGS

	LEDGE				CRUSTACEOUS				VENEER			
	B	M	L	D	B	M	L	D	B	M	L	D
MOLARS	24	28	20	26	16	12	12	14	-	-	-	-
PREMOLARS	14	20	20	24	34	18	27	28	2	2	2	2
CANINES	16	12	18	14	26	32	26	34	-	-	-	-
INCISORS	14	18	12	14	24	26	34	30	-	-	-	-

The frequency of calculus types according to tooth surfaces of all the teeth studied is shown in Fig. 5.

In the 200 canine and premolar tooth surfaces examined, no subcalcular space of less than 2 mm. was noted. Seven per cent of the molar root surfaces and 2 per cent of the incisor root surfaces had a subcalcular space of only 1 mm. (Table III.)

TABLE III

VARIATION IN DEPTH OF THE SUBCALCULAR SPACE IN THE VARIOUS TOOTH GROUPINGS. TWO HUNDRED SURFACES STUDIED IN EACH TOOTH GROUP

	DEPTH IN MILLIMETERS										
	1	2	3	4	5	6	7	8	9	10	AVERAGE DEPTH
MOLARS	14	88	44	20	4	-	-	-	-	-	2.5
PREMOLARS	-	124	60	10	4	-	2	-	-	-	2.5
CANINES	-	102	58	12	2	-	-	-	-	-	2.8
INCISORS	4	102	64	6	4	-	-	-	-	-	2.4

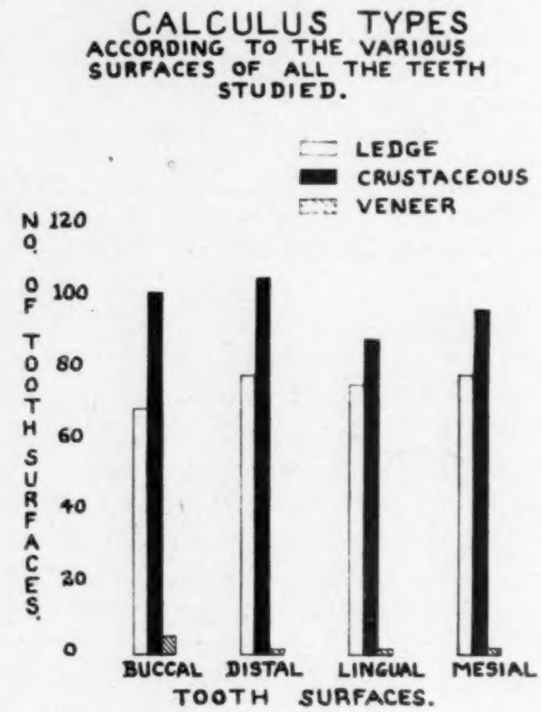

Fig. 5.

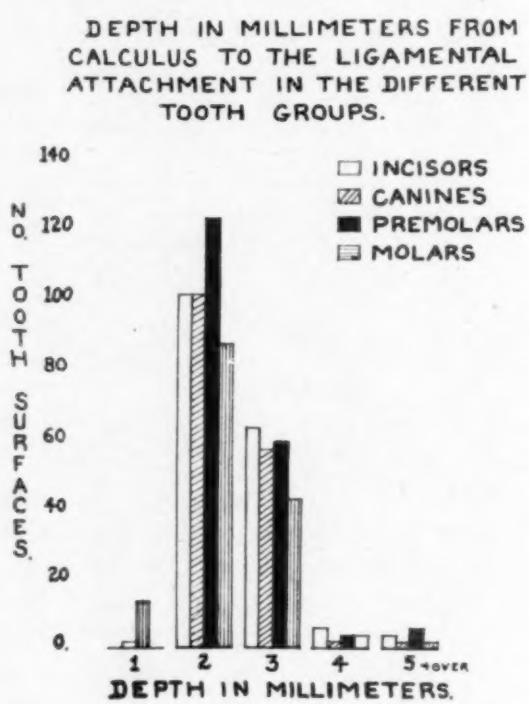

Fig. 6.

The subcalcular measurement was unrelated to the calcular type, the tooth surfaces involved, and the various tooth groupings. The depth of the subcalcular space in the various tooth groupings is depicted graphically in Fig. 6.

The above data, derived from a detailed examination of 800 tooth surfaces of four tooth groups, revealed that there was close uniformity in the subcalcular space measurements and the frequency of involvement of the tooth line angles. It was felt that, rather than continuing this detailed study, more information might be obtained by examining a larger number of teeth to determine (1) whether any subcalcular space measurement of less than 1 mm. was found, and (2) whether there existed other types of calcareous deposits not included in the original classification. Accordingly, an additional 800 teeth obtained at random from the extraction clinic were studied in these respects. On the 3,200 tooth surfaces of this second group no subcalcular measurement of less than 1 mm. was recorded, and in the majority of instances a subcalcular measurement of over 2 mm. was noted. No additional types of calculus were found nor any variations of form not observed in the 200 teeth studied in detail.

DISCUSSION

These data and observations are subject to the following errors: The buccal and lingual surfaces of many teeth had been mutilated by the forceps, and wherever such disturbance of the calculus was observed it was recorded as being present. This was permitted by a study of cadaver's teeth in situ where it was found that, on every tooth undisturbed by dental care or extraction, the subgingival calcular deposits were circumferential in distribution. Another possible cause of error is the source of the teeth studied, which were obtained from the extraction clinic of the University of Pennsylvania. The patients were mostly from low subsistence levels and little, if any, previous dental care had been received. Lastly, no record was included of any tooth that had no evidence of subgingival calculus, thereby eliminating teeth from adolescent ages or from patients who had received adequate dental care.

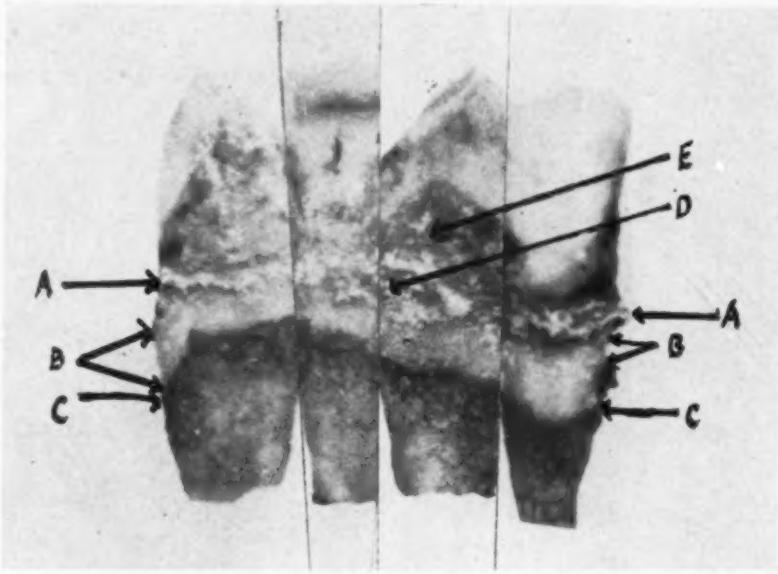

Fig. 7.—Canine calculus formation in pockets from 3 to 6 mm. in depth.

Morphologically, the calcular deposits fall easily into the three stated classifications. From its position in the subgingival space, the ledge type is apparently the first type to form and, when undisturbed, the crustaceous type seems to be an outgrowth from it, usually in an apical direction. The ledge, however, in all specimens examined, was nearer to the cervical line than it was to the ligamental attachment.

In Figs. 7, 8, and 9, showing the four surfaces of three teeth cut at their line angles and matched together, the circumferential character of the calculus is demonstrated clearly. The ledge type of calculus seems to be the first formed, and it is deposited in a circumferential manner. It tends to remain in the original position unless disturbed. The crustaceous type of calculus forms apically and coronally from the original ledge deposit.

The three teeth represented in Figs. 7, 8, and 9 were selected also because of the wide difference in the subcalcular space measurements.

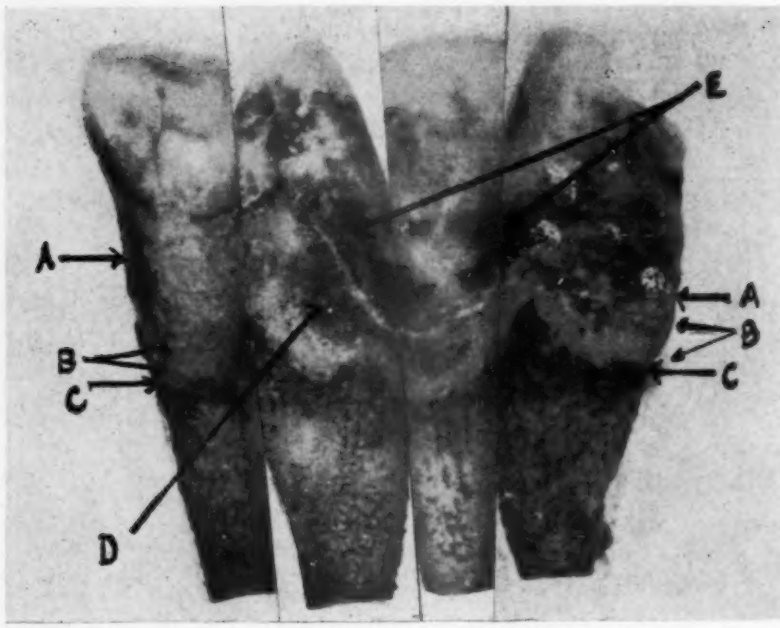

Fig. 8.—Upper first incisor calculus formation in pockets from 4 to 8 mm. in depth. *A*, Calcular ledge; *B*, subcalcular crevice; *C*, ligamental attachment; *D*, crustaceous calculus apically from ledge; *E*, crustaceous calculus coronally from ledge.

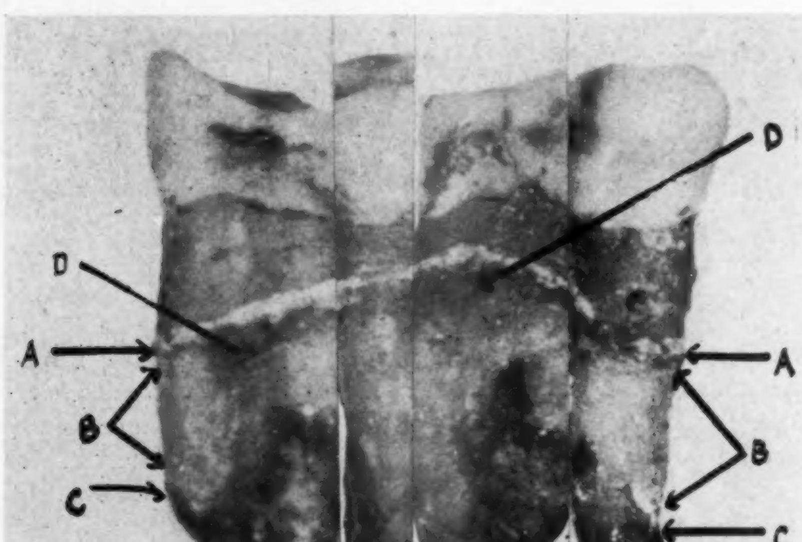

Fig. 9.—Premolar calculus formation in pocket extending almost to apex.

The four surfaces of a tooth photographed, the prints cut at the line angle and matched together at the calcular deposit areas, demonstrating the circumferential character of the calcular formation.

The upper canine is a typical example of the calculus formation on a tooth with pockets of 3 to 6 mm. in depth, the upper first incisor typical of pockets of 4 to 8 mm. in depth, and the premolar typical of pockets extending practically to the apex, yet the position of the ledge portion of the calculus in reference to the enamel-cemental junction remains fairly constant.

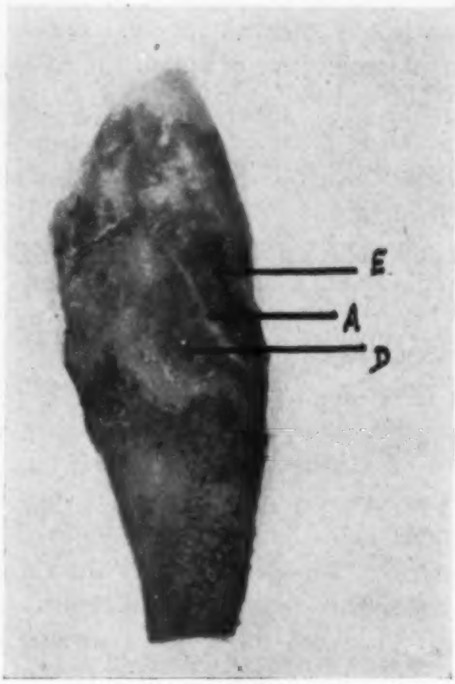

Fig. 10.

Fig. 11.

Fig. 10.—Approximal surface of canine. *A*, Calcular ledge; *D*, crustaceous type apically from ledge; *E*, crustaceous type coronally from ledge and continuous with it.

Fig. 11.—Approximal surface of premolar. *A*, Calcular ledge; *C*, ligamental attachment; *F*, new calcular mass. *H-H*, Between these two points the ligamental attachment has receded apically to maintain its subcalcular crevice.

The crustaceous type of calculus is exemplified in Fig. 10. This type was situated usually on the surface of the root apically from the original ledge and occupied a greater area than the ledge type. The slow growth apically of this crustaceous mass either followed the recession of the ligamental attachment or was a causative factor in its recession. In Fig. 11 the irregular ledge is seen and, at its lowest point and separate from it, there is a new calcular mass, adjacent to which the ligamental attachment has already receded apically, resulting in the maintenance of the average distance on the root separating the lowest calcular mass from the ligamental attachment. This localized recession is best explained as due to irritation from the small crustaceous deposit on the cementum.

This observation corroborates Burchard's description of a calcular mass, or islands, in the subgingival crevice, which he termed "nodules," and supports his view that the ligamental recession seems to be due to calcular irritation. No examples of multiple nodules described by Burchard were found in this

study. The extensive distribution of the crustaceous type of calculus may have given Burchard the impression of multiple nodules.

Kirk first designated some calculus as "smooth," judging from the tactile sensation. He suggested that this was produced frequently by incomplete removal of the calculus and a polishing of the calcular surface as though it was cementum. The term "veneer" is used in this paper to designate this artificial type of calculus. From clinical experience it occurs always coronally from the ledge, if the ledge be present, but it may constitute the entire subgingival calcular surface. In such a case no ledge or crustaceous type exists on the same surface. It is never found below the ledge.

The infrequency of the veneer type of calculus in the teeth examined from the extraction clinic, and the frequency with which it is observed in private practice suggests that Kirk's inference of an artificial causation is probably true. A dull instrument will frequently cause a mass of calculus to be planed to a smooth surface which will deceive the tactile sense, whereas a sharp instrument will indicate tactically the difference between the veneer type and cementum. The position on the root surface as mentioned indicates that it is the result of failure to remove the calcular mass entirely.

The most important observation of this macroscopic study of the morphology of the root surface is the consistent presence of a subcalcular space, varying from 1 to 10 mm. in depth, which presents an apparently healthy and clean surface of cementum. The stratified squamous epithelium of the crevicular gingiva is in apposition to this subcalcular space which is bounded by the calcareous deposits and the ligamental attachment. This area is termed the subcalcular crevice, which can be considered a division of the gingival crevice. The existence of the subcalcular crevice is of marked significance. It furnishes an area which permits proper instrumentation without causing injury to the soft tissue wall of the crevice or the ligamental attachment. It furnishes an important tactile landmark in instrumentation which must be recognized by the operator.

Attempts to stain this subcalcular crevice before extraction, to determine whether the epithelium lining the crevice was in apposition or attached to the cementum were inconclusive. It was a simple matter to insert the instrument or stain to the depth of the interseptal fibers, but impossible to determine whether the epithelium was detached or merely separated from the cementum in the process.

The clinical aspects of this study which are concerned with the type of scalers, and the technique of instrumentation which are best adapted for the efficient removal of subgingival calculus will be discussed in another paper.

SUMMARY

1. Subgingival calculus can be divided morphologically into three types: the ledge, the crustaceous, and the veneer.

2. The ledge type of calculus is usually the first formed and, if undisturbed, it maintains its original position however deep the pocket may become.

3. The crustaceous type of calculus is an outgrowth from the ledge form, usually developing in an apical direction, but it may extend in a coronal direction.

4. The veneer type of calculus is derived from the preceding types by improper instrumentation.

5. A calculus-free area of cementum, carrying from 1 to 10 mm. in depth, was observed uniformly between the calcareous deposits and the ligamental attachment. It has been called the subcalcular space.

6. With the teeth in situ this subcalcular space with the crevicular gingiva forms the subcalcular crevice. The subcalcular crevice is of marked significance as it is an area which permits proper instrumentation and the efficient removal of calculus without injury to the soft tissue wall of the crevice and the ligamental attachment. It furnishes an important tactile landmark in instrumentation which must be recognized by the operator.

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A HISTOPATHOLOGIC EXPLANATION FOR THE ORAL LESIONS IN THE ACUTE LEUCEMIAS

LESTER W. BURKET, D.D.S., M.D.*

IN SPITE of the rarity of the blood dyscrasias, they are of considerable dental importance because the dentist is frequently consulted first for the treatment of the gingival hemorrhage, hypertrophy, or ulcerations. Dental operations on these patients result often in a fulminating spread of the painful ulcerations, and a rapid, fatal termination of the disease. While the dentist may not be directly blamed for this unfortunate and as yet inevitable outcome, he is usually criticized for not recognizing the true nature of the oral lesions.

The leucemias are characterized by a marked increase in the number of white blood cells in the circulating blood and the tissues. The systemic symptoms and the oral lesions of all types of acute leucemia are similar. They consist of marked gingival hypertrophy, and necrosis of considerable areas of the gingival tissues and oral mucosa. There is little accompanying inflammatory reaction. The odor from the necrotic tissue, the decomposing blood from the gingival hemorrhage, and the resulting lack of oral hygiene is frankly putrid. It is distinct from that encountered in acute fusospirochetal disease. The earliest mouth lesions are usually seen in the maxillary molar region and in the lower anterior region, although they may develop in any area of the mouth. The gingivae are swollen, spongy, deep purple in color, with greatly enlarged and ulcerated interdental papillae.

All the other soft dental tissues may become involved. The teeth become loosened rapidly, and extensive destruction of the alveolar process occurs within a relatively short time in acute leucemia. These patients complain often of a severe odontalgia without apparent clinical cause. Prinz and Greenbaum described liquefactive necrosis of the pulps of apparently sound first incisors. Localized areas of liquefaction necrosis or pulpal "abscesses" are observed frequently in noncarious teeth. The writer has seen multiple discharging fistulas in the mucobuccal fold opposite the apices of the deciduous teeth in a 4-year-old child with acute myelogenous (eosinophilic) leucemia, although no cavities were detected in the crowns of the teeth.

The general pathologic findings in this disease reveal a marked increase in the number of abnormal and normal-appearing white blood cells in the vascular system, and dense accumulations of similar cells in the bone marrow, spleen, lymph nodes, and other viscera, resulting in a marked increase in the size of the involved organs. Circulatory stasis may occur, and result in secondary tissue changes due to lessened resistance or impaired nutrition.

From the Department of Oral Medicine, School of Dentistry, The Thomas W. Evans Museum and Dental Institute, University of Pennsylvania.

Material collected under a Sterling Fellowship in Pathology, Graduate School of Medicine, Yale University, 1935-1936.

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Similar processes might be expected to take place in the dental tissues, but because of their environmental and anatomic relations, different symptomatology may be experienced.

The histopathology of the oral lesions in the acute leucemias has not been studied extensively. Biopsy examinations are made infrequently because of the undesirable complications and clinical course of the disease following even minor surgery. Thoma described an even infiltration of the "leucemic" cells in the gingival tissues. Spitzer noted lymphocytic cells in the blood vessels of the pulp. Necropsy studies of the oral lesions in leucemia have not been recorded, to the author's knowledge.

CASE REPORT: ACUTE MONOCYTIC LEUCEMIA

The patient, a 12-year-old boy, was admitted to the New Haven Hospital complaining of toothache and pain in the lower jaw, decreased appetite, a sallow color, and intermittent pains in the abdomen for two weeks. The day before admission the patient was taken to the dentist, who extracted a lower left first molar. There was an acute reaction following the removal of this tooth and the next morning there was a marked increase in swelling on the left side of the neck and the patient had a temperature of 102° F. He was hospitalized for observation and diagnosis.

The patient was a pale, ill-looking boy, who was breathing through his mouth. There was a foul, putrid odor to his breath. The lips were pale and dry, and the tongue was heavily coated. The gums were swollen, dusky red, and tender. Many carious teeth were present. The gingival hypertrophy and the ulceration were especially marked in the region of the recent extraction.

The cervical lymph nodes were large, discrete, nonfluctuant, and freely movable. In the left side of the abdomen a mass was palpable which was thought to be the spleen. No petechiae were noted anywhere on the body. The other findings were essentially negative.

The dental consultant thought that the gingivitis and adenitis were secondary to some blood dyscrasia. The swelling of the face, lips, and gingivae increased, as did that of the spleen. The necrosis of the gums became more extensive. Pain and a foul putrid odor were outstanding symptoms.

The patient died three weeks after he first began to tire easily, eight days following the removal of the lower left molar, and two weeks after the onset of the jaw and abdominal symptoms.

The blood counts on various occasions are shown in Table I.

TABLE I

1934	R.BC. (C.MM)	HGB. (%)	W.B.C. (C.MM.)	P.M.N. (%)	LYM. (%)	MONO. (%)
7/29	1,870,000	40	6,100	27	53	10
7/30	2,610,000	46	13,700	13	74	11
8/1	2,100,000	44	28,000	5	7	86
8/3	1,890,000	40	40,600	0	15	85
8/5	850,000	30	78,800	2	23	75

Bleeding time: 3 minutes
Clotting time: Capillary tube, 4 minutes; large tube, 1 minute

Clinical diagnosis: Monocytic leucemia.

Anatomical diagnosis: Generalized lymph node enlargement; hyperplasia of the bone marrow; splenomegaly; multiple petechiae in the skin, conjunctivae, sclerae, pleurae, liver, and kidneys; necrotizing gingivitis.

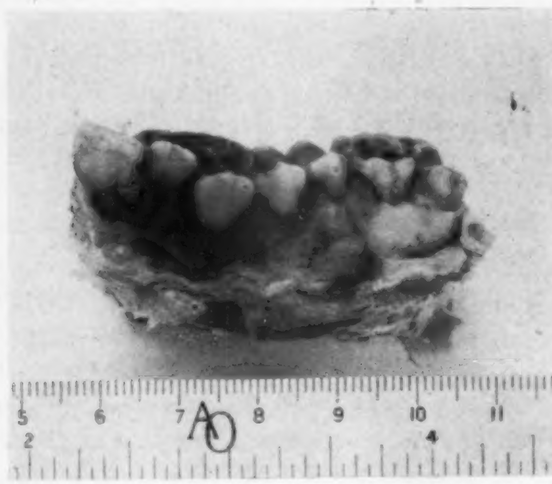

Fig. 1.—Gross specimen, buccal aspect.

Fig. 2.—Gross specimen, palatal aspect.

ORAL PATHOLOGIC FINDINGS

The specimen obtained for the oral pathologic studies consisted of that portion of the right maxilla containing the teeth from the first incisor to the third molar. The gingival tissues were reddish purple in color and hypertrophied throughout. The interdental papillae were markedly enlarged and ulcerated. Extensive areas of necrosis were observed buccally and lingually in the region of the second incisor, canine, and first premolar teeth, and on the lingual in the region of the second molar (Figs. 1 and 2.)

Fig. 3.—Marked hypertrophy and necrosis of the gingival tissues in the canine region. (×2½.)

Fig. 4.

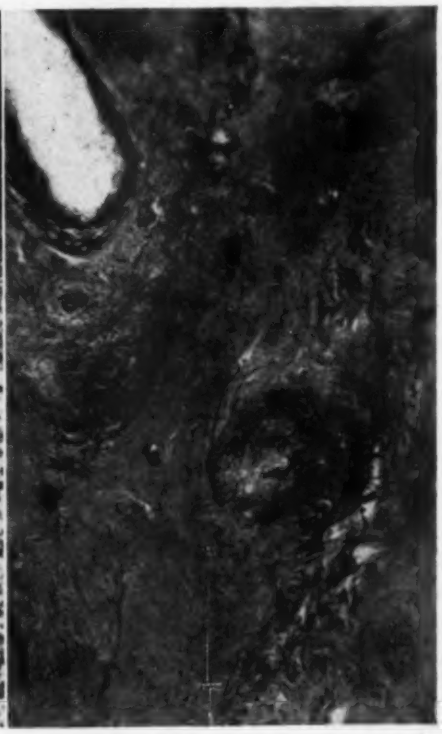

Fig. 5.

Fig. 4.—Mononuclear infiltration in the gingival tissues. (×65.)
Fig. 5.—Thrombosed vessels and necrosis in the gingival tissues with more marked lesions. (×35.)

Gingiva.—There is a marked hypertrophy of both the marginal and alveolar gingivae. (Fig. 3.) The epithelial tissues are missing over the marginal gingivae. Where the structural elements are still distinguishable, the usual architecture of the gingival tissues is almost entirely replaced by a dense accumulation of large mononuclear cells. (Fig. 4.) In other regions the tunica propria is markedly widened and stains poorly, indicating beginning necrosis. The necrosis of the gingival tissues is most marked about the thrombosed vessels in the marginal and alveolar gingivae. (Fig. 5.)

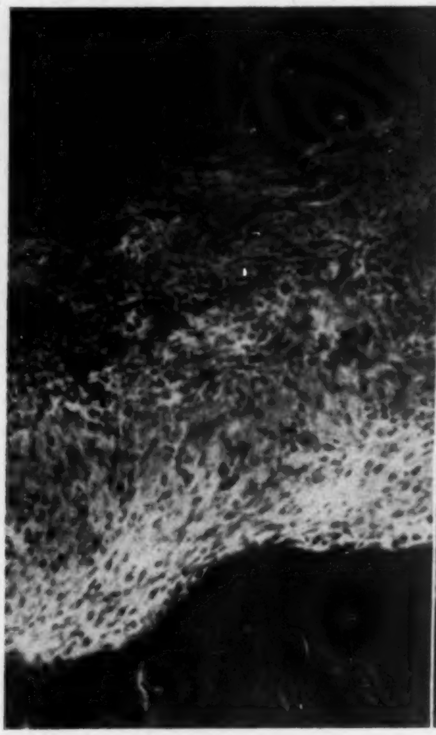

Fig. 6.

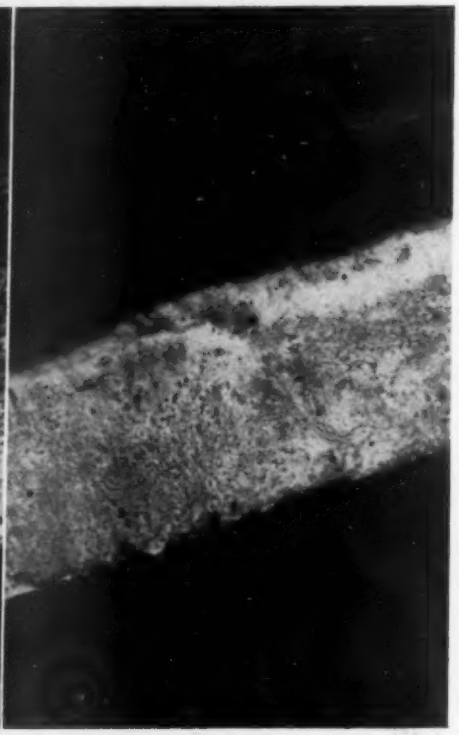

Fig. 7.

Fig. 6.—Mononuclear infiltration in the dental periosteum. (×65.)
Fig. 7.—Necrosis of the dental periosteum. (×35.)

Dental Periosteum.—The usual structural architecture of the dental periosteum is well preserved in the apical region of the teeth. In the middle third of the dental periosteum next to the alveolar bone there are numerous localized areas where there is a loss of the usual structural elements and staining qualities of the tissues, which is suggestive of beginning necrosis. (Fig. 6.) In the dental periosteum adjacent to these areas many extravascular, large mononucleated cells are seen. Small thrombosed blood vessels could be observed in these regions. Few cellular elements could be distinguished in the gingival third of the dental periosteum of the most extensively involved teeth. There was diffuse necrosis of the tissue elements in this region with only an occasional "ghost" mononuclear cell scattered throughout the amorphous faintly staining tissue. (Fig. 7.)

Alveolar Bone.—The adipose tissue which normally occupies the alveolar marrow spaces of the upper jaw was infiltrated by a large number of mononuclear cells, which gave a highly cellular appearance to this tissue. (Figs. 8 and 9.)

Dental Pulp.—There was a diffuse fibrosis of the pulpal tissues. Many of the small blood vessels were completely filled with closely packed monocytic cells. Large numbers of similarly appearing cells were scattered throughout the dental pulp. These extravascular mononuclear cells were particularly prominent beneath the odontoblastic layer. (Fig. 10.)

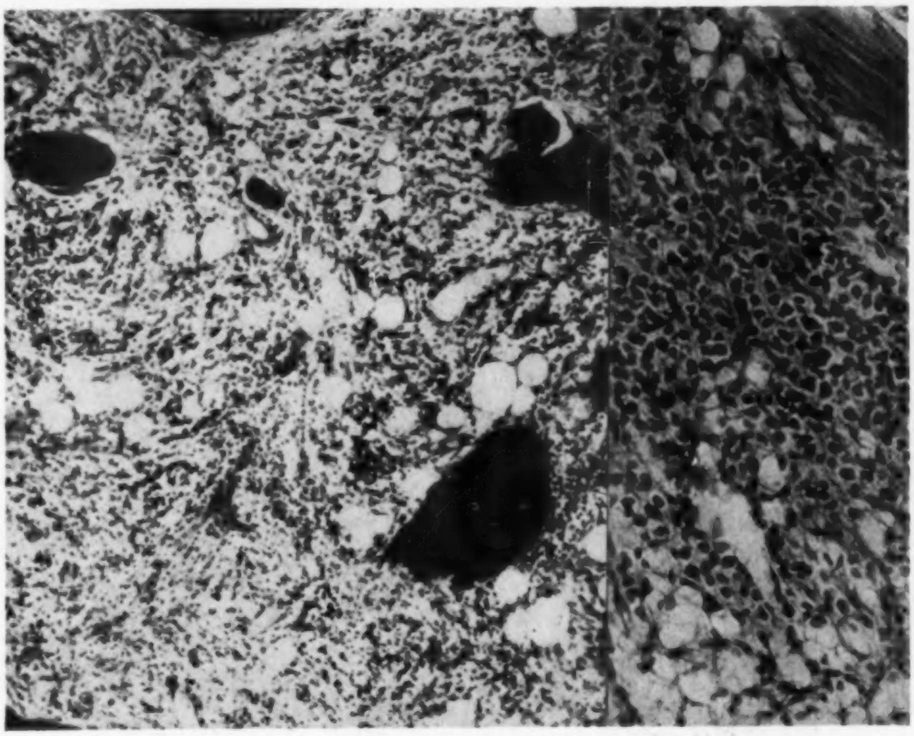

Fig. 8. Fig. 9.

Fig. 8.—Mononuclear infiltration in alveolar marrow spaces. (×35.)
Fig. 9.—Mononuclear cells in the alveolar marrow spaces. (×85.)

DISCUSSION

The histopathologic studies of this case afford a pathologic explanation for many of the clinical oral symptoms which are so characteristic of the acute leucemias. The massive necrosis of the gingivae, which occurs so frequently in this disease, is the result of thrombosis of the blood vessels supplying these tissues. No frank rupture of the blood vessels could be seen in the serial histologic sections. The thrombosis of the gingival vessels explains why the necrosis is so extensive and why it is not accompanied by any marked inflammatory reaction. The hypertrophy of these tissues results from the large extravascular "leucemic infiltration" and secondary changes which are common to any infarcted area.

The rapid loosening of the teeth in the acute leucemias is the result of early necrosis of the dental periosteum. The "woody," artificial feel of the teeth is due to the extravascular accumulation of mononuclear cells in the dental periosteum. The marked "tightening" of the teeth which accompanies periods of therapeutically induced remissions can be explained by the disappearance of the "leucemia infiltration" from the dental periosteum and possible reattachment of the dental periosteal fibers to the alveolar bone.

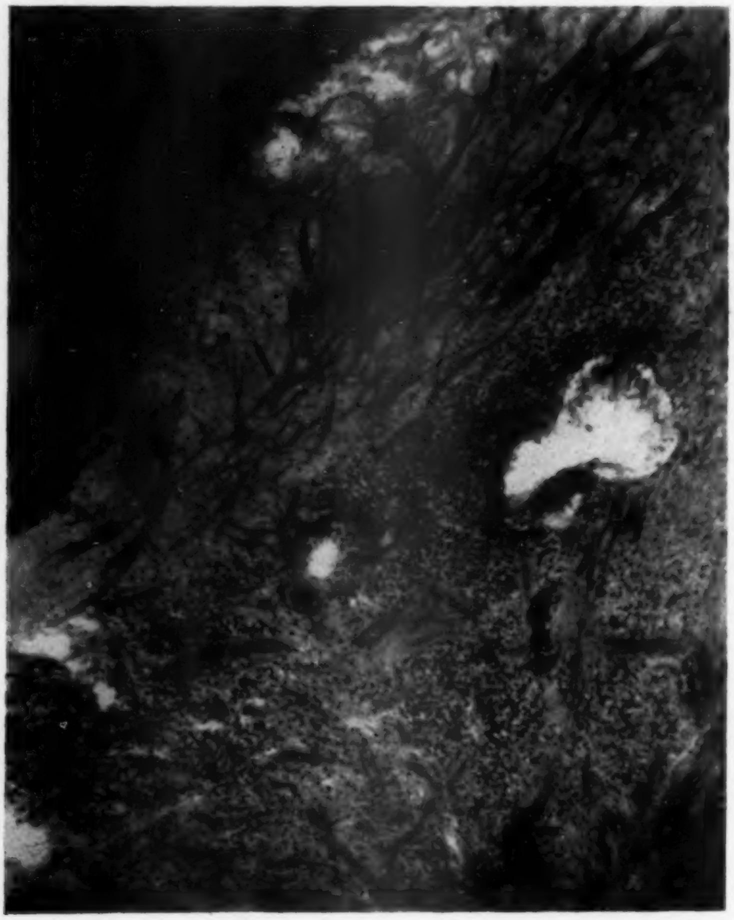

Fig. 10.—Fibrosis and mononuclear infiltration of the dental pulp. (×35.)

These histopathologic studies afford no explanation for the spontaneous pulpal and periapical "abscesses" which are often observed in the acute leucemias. In view of the recorded pulpal changes, it is probable that the spontaneous abscess formation is the result of secondary infection of focal areas of liquefaction necrosis of the dental pulp and periapical tissues, resulting from the thrombosis of the nutrient vessels or actual strangulation of the pulpal tissues due to a massive "leucemic infiltration." The extravascular collection of large mononuclear cells in the pulpal tissue, especially beneath the odontoblastic layer, affords a ready explanation for the odontalgia which is experienced by patients with acute leucemia.

SUMMARY

The oral lesions associated with the acute leucemias have been reviewed. A case of acute monocytic leucemia is reported which illustrates the dental aspects of this disease and the rapid and unfavorable clinical course which follows operative procedures, such as dental extractions, in these patients.

The post-mortem histologic findings of the teeth and jaws in this case are one of the first complete pathologic studies of the oral lesions in leucemia. They furnish a pathologic explanation for the varied oral symptomatology. Aside from modifications due to the local environmental and anatomic peculiarities of the involved tissues, the histopathologic changes observed in the teeth and jaws are similar to those occurring in other organs of the body.

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DIFFERENTIAL BLOOD COUNT IN PERIODONTAL DISEASES. A PRELIMINARY REPORT ON BLOOD OBTAINED FROM THE GINGIVAL TISSUES AND THE FINGER TIP

JOHN H. STINE, D.D.S.,* AND LESTER W. BURKET, D.D.S., M.D.*

THE importance of systemic changes associated with periodontal diseases is becoming increasingly apparent. Healy, et al.,[1] suggested that allergy may be a frequent etiological factor. The finding of high eosinophile counts in the gingival blood was taken as an indication of allergic periodontal disease. Similarly, in the case of doubtful nasal allergy, a predominance of eosinophiles in the nasal secretion confirms the suspicion of allergy.[2] When differential leucocyte counts show an eosinophilia in any suspected case of allergy, this is considered additional positive evidence, although its absence does not necessarily exclude it.[3]

In an effort to evaluate by this method the importance of allergy in periodontal diseases, a group of 200 patients was studied, all of whom presented a clinical picture of periodontal disease of one form or another. In each of these patients a differential count was made of blood obtained from both the gingival tissues and the finger tip.

Gingival blood is obtained by the following technique: The mouth is thoroughly rinsed and the area from which the blood is taken is dried, and capillary hemorrhage induced by curettage. The blood sample is then collected in a glass tube drawn to capillary size at one end. The other end is attached to an ordinary rubber tube, which is used to control the collection of the sample. The blood smear is then made by blowing the contents of the capillary tube on a glass slide. The standard Wright's stain is used. In making the differential counts for this study, 200 cells were counted.

Fig. 1 shows the distribution of the total leucocyte counts from finger-tip blood in the 200 cases. The counts ranged from 3,500 to 16,000/c.mm. with an average of 7,000/c.mm.

Fig. 2 shows the distribution of eosinophiles as ranging from 0 to 9 per cent with an average of 2 per cent.

Fig. 3 shows the relation of gingival to finer-tip eosinophiles for each of the 200 cases. Finger-tip eosinophile per centage is represented along the base line, and gingival eosinophile per centage along the vertical line. The cases included within the heavy-lined large square, 162 in number, had an eosinophile count within normal limits of 0 to 4 per cent. The cases beyond the limits of the large square all had an eosinophile count of over 4 per cent in either or both the gingival and finger-tip blood. The diagonal line running from the 0,0 point divides the cases so that those lying above the line have a higher gingival than finger-tip eosinophile count, those below the line have a higher finger-tip

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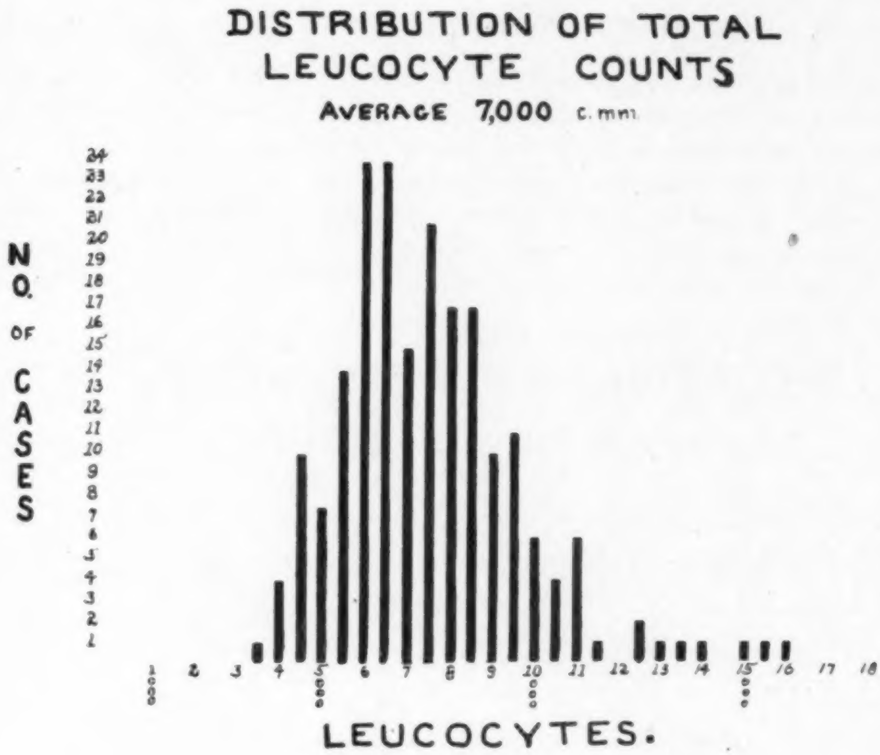
DISTRIBUTION OF TOTAL LEUCOCYTE COUNTS
AVERAGE 7,000 c.mm.
NO. OF CASES
LEUCOCYTES.

Fig. 1.

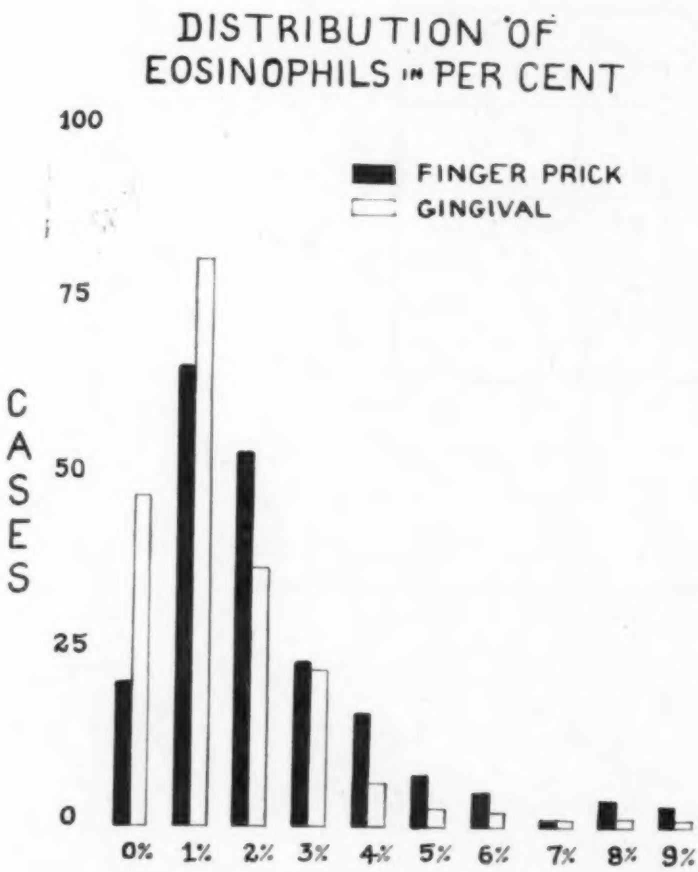
DISTRIBUTION OF EOSINOPHILS IN PER CENT
FINGER PRICK
GINGIVAL
CASES
100
75
50
25
0
0% 1% 2% 3% 4% 5% 6% 7% 8% 9%

Fig. 2.

than gingival count, and those in the squares through which the diagonal line passes have an equal eosinophile count in both finger-tip and gingival blood.

A higher eosinophile count was found in the gingival blood in 37 (18.5 per cent) of the 200 cases. Of the 200 cases, 38 (19 per cent) showed an eosinophilia of 4 per cent or over in either the gingival or the finger-tip blood. Of these cases, 30 showed an eosinophile count of less than 4 per cent in one of the two samples. A definite history of allergy was uncovered in nine (23 per cent) of the 39 cases.

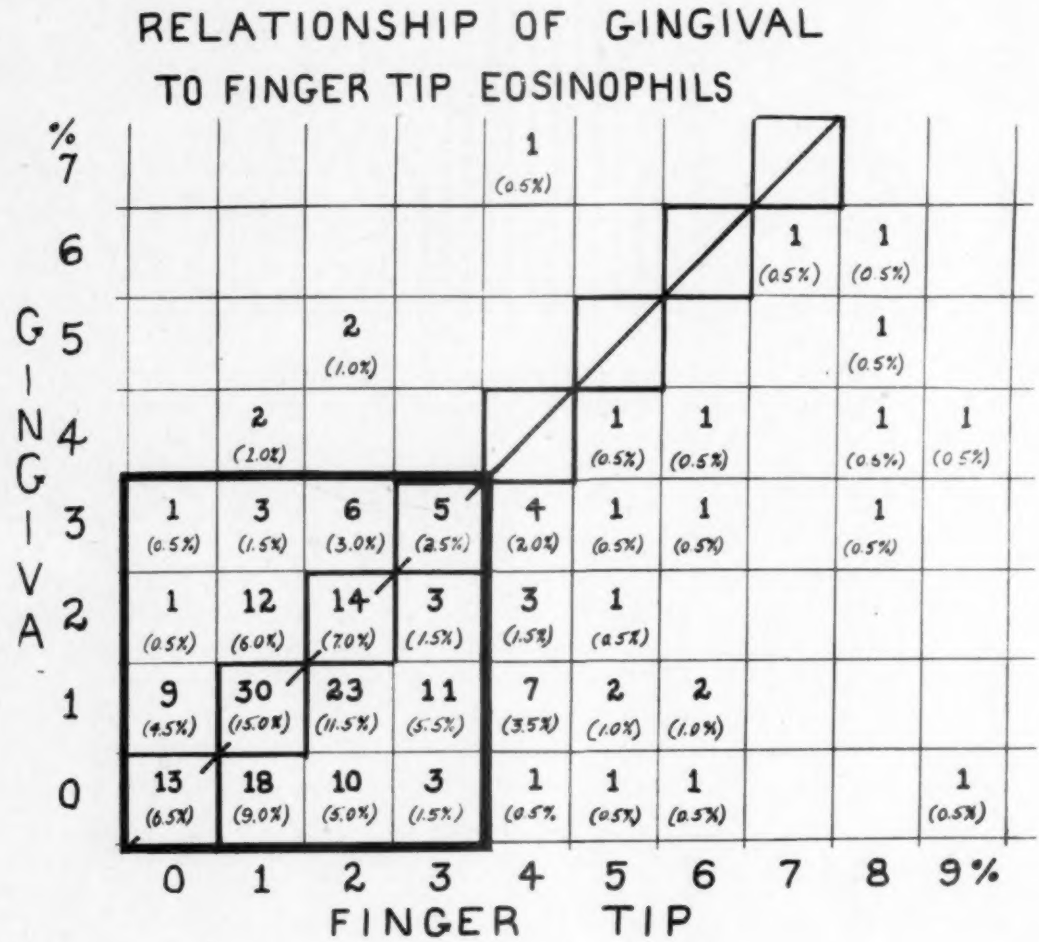

Fig. 3.

The gingival eosinophile count was greater than the finger-tip count in just five cases (12.8 per cent) as shown in Table I.

TABLE I

CASE	GINGIVA		FINGER TIP	
	ABSOLUTE NO. EOSINOPHILES/C.MM.	%	ABSOLUTE NO. EOSINOPHILES/C.MM.	%
1	296	4	74	1
2	220	4	55	1
3	380	5	152	2
4	630	5	252	2
5	280	7	160	4

It will be observed that in Case 5 only were both the gingival and fingertip eosinophiles over normal. In none of these five cases was a history of known allergy discovered. No attempt was made to treat these five cases on the assumption that allergy was an etiological factor. Their response to routine treatment was satisfactory.

CONCLUSION

It appears that allergy as evidenced by a local eosinophilia was not found to be an important etiological factor in the causation of periodontal diseases in this group of patients. This, however, does not exclude allergy as an etiological factor.

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DIAGNOSIS AND TREATMENT OF DISEASES OF THE PULP AND PERIAPICAL TISSUES

LOUIS I. GROSSMAN, D.D.S., DR. MED. DENT.

CORRECT treatment is based upon correct diagnosis. The word diagnosis literally means knowing apart or recognizing one disease apart from another. It is the art of distinguishing or identifying disease. Diagnosis may be clinical or laboratory depending upon whether the diagnosis is arrived at from symptoms and objective examination alone, or whether it is aided by laboratory tests. The former may include certain means of examination, e.g., inspection palpation, percussion, etc., readily performed with the senses alone or with simple mechanical aids. The latter may include roentgen ray examination, biopsy, biochemical tests, etc. Differential diagnosis is the identification of a disease by comparing somewhat similar symptoms of various diseases.

The examination may be subjective, i.e., what the patient informs the examiner, or objective, i.e., what the examiner learns by his senses.

For the diagnosis of diseases of the pulp or periapical tissue, certain tests may be used. These are: (a) x-ray, (b) electric pulp test, (c) thermal test, (d) transillumination. In addition, simple clinical tests such as percussion and palpation, for which no special instruments are required, may be used. A few brief comments upon each of these tests so far as they apply to our special field of endodontia will now be made.

X-RAY

The x-ray is an invaluable diagnostic aid without which one cannot practice dentistry, particularly root canal therapy, adequately. It may tell us which tooth is involved, by disclosing the presence of caries close to the pulp, by the condition of the periapical tissue, etc., or it may tell us that the tooth is beyond treatment. If root canal therapy is planned it may help to disclose the number and shape of the roots, width and course of the root canals, whether the canal is negotiable, etc. It helps to lead us out of the dark as no other diagnostic aid can. Despite its great helpfulness, it has certain limitations which should be recognized. It presents only a two-dimensional picture of a three-dimensional object so that a root canal may appear to be narrow in one dimension on the x-ray film yet actually be wider in another dimension, or conversely. The x-ray film may show periapical radiolucency, yet this may be due to an anatomic variation (as presence of red marrow in bone), or to trauma (following a blow, yet tissue may be sterile), or to the fact that not enough time had elapsed between root canal treatment and repair to have taken place, or to orthodontic treatment. Or, conversely, in cases of acute abscess, periapical infection may be present, yet no area of radiolucency can be seen. Despite its limitations, the x-ray is a most valuable diagnostic aid, before, during, and after root canal treatment.

Probably the next most useful diagnostic aid is the electric pulp test. Of several electric pulp-testing apparatuses on the market, the writer has found

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the vitalometer to be one of the more reliable. While its accuracy is probably below that claimed for another type of pulp tester by Kaletsky,[1] it is nevertheless satisfactory for practical use.

It is well to remember in using this type of apparatus that (a) the tooth being tested should be dry. It is not enough to dam back the saliva with cotton rolls; in addition, the tooth should be dried with a large cotton pellet or, preferably, with compressed air. (b) The tooth electrode should be applied against the incisal or occlusal third of the labial or buccal surface of the tooth. This area is generally free from fillings, is exposed to less incisal or occlusal wear, presents a relatively flat surface for contact with the electrode, etc. (c) Conductivity of the tooth electrode may be enhanced by placing a drop of tooth paste instead of water in the concavity of the electrode. This also precludes the possibility of water running from the electrode onto the gingiva and so causing a periodontal instead of a pulp reaction. (d) A more accurate reading will be had if the current is turned up slowly. (e) At least one control tooth, preferably more, should be tested for each tooth that gives an apparently abnormal reaction. (f) A deviation of $\pm$ 1 unit on the scale for anterior teeth and $\pm$ 2 units for posterior teeth should be considered within the normal range. Greater deviations sometimes occur depending upon the amount of secondary dentine, presence of large cavity or filling, and differences in thickness of enamel covering.

THERMAL TEST

Whereas the electric pulp test is primarily a quantitative test, the thermal test is principally a qualitative test. In the former the response is measured in units on a scale, while in the latter the response is measured either (a) by pain or lack of pain, or (b) by length of time necessary to produce a feeling of discomfort. In some cases, as in a tooth with a hyperemic pulp, the response is that of pain, while in certain cases of pulpitis there is no pain but it takes either a longer or shorter time to produce a sensation of cold or of heat. The stimulus may be cold, produced by (a) ice, (b) ethyl chloride spray, (c) compressed air. If ice is used, it may be formed into a cone in the refrigerator as suggested by Austin and Waggener.[2] The simplest means of applying cold to a tooth is to cut a single hole in a sheet of rubber dam, slip the dam over the tooth to be tested, then direct a stream of ethyl chloride on the tooth. The response is either that of cold or of pain, depending upon the tooth being tested and the patient's sensibilities. A control tooth should be tested in a similar manner. Heat may be applied by means of (a) a hot ball-end burnisher, (b) hot gutta-percha on an instrument. The gutta-percha should be heated until vapors just begin to issue from it, but not long enough to char the material. In questionable cases, cold should immediately follow heat, or vice versa, in order to elicit the maximum response. Again, one must be guided by the reaction of a control tooth or teeth to similar testing in order to evaluate the reaction of an involved tooth.

TRANSILLUMINATION

While transillumination was popular for a time, it is little used today because it requires a dark or darkened room and because other means of diagnosis are probably simpler and give more information. It is of very little or no value in diagnosing pulp disease and is of limited value in diagnosing periapical disease. It may disclose periapical destruction, but the nature and extent of the

TABLE I

DIAGNOSTIC TABLE: DISEASES OF THE PULP AND PERIAPICAL TISSUES

	NO PAIN	SHARP PAIN	DULL PAIN	THROBBING PAIN	LOCALIZED PAIN	DIFFUSE PAIN	INTERMITTENT PAIN	CONTINUOUS PAIN	PAIN > HEAT	PAIN > COLD	PAIN > SWEET	PAIN > SOUR	PAIN > MASTICATION	PAIN > LYING DOWN	DURATION OF PAIN	FISTULA	INTRAORAL SWELLING	EXTRAORAL SWELLING	PERIODONTITIS	ELECTRIC TEST—AMOUNT OF CURRENT	THERMAL TEST—ABNORMAL TO HEAT	THERMAL TEST—ABNORMAL TO COLD	X-RAY EXAMINATION—AREA OF RAREFACTION
Hyperemia		A		A	G		A		O	A	G	G		G	Sec.						A	A	None
Acute serous pulpitis		A		A	G		G			G	A	A		G	Min.						A	A	None
Acute suppurative pulpitis			A		A	O		A	A				O							G– O+	A		None
Chronic ulcerative pulpitis	O		G	G	G	O	A						A							+			None
Chronic hypertrophic pulpitis	O		G		A		A						A							+			None
Necrosis or gangrene	G		A		G			A	A				O						O	+NR	A	NR	None; or thickened PM
Acute abscess			A	O	G	O		A	A				A			O	G	O	G	NR	A	NR	None; or thickened PM
Chronic abscess	G		A		G		G						G			O	O			NR	O	NR	Diffuse
Subacute abscess			A	O	G			G	G				A			O	O		G	NR	A	NR	Diffuse—no trabeculation
Granuloma	G		A		A		G						O			O	O			NR	O	NR	Circumscribed
Cyst	G																O	O		NR	NR	NR	Circumscribed

A, Practically always; G, generally; O, occasionally; +, more; –, less; >, increased by; NR, no response; PM, periodontal membrane.

destroyed bone is preferably determined by x-ray examination. As an adjunct in diagnosis, however, it nevertheless has its place.

No single test should be relied upon exclusively. In many cases it will be necessary to carry out two or more tests in order to insure that a correct diagnosis has been made. Corroborative evidence from at least two different kinds of tests is always desirable.

It should be borne in mind that these tests are only aids to diagnosis and that correct diagnosis may be established from subjective and/or objective symptoms alone. One should listen carefully to the patient's recitation of symptoms. One should learn to question the patient in order to draw out to the fullest extent information which may be helpful in arriving at a diagnosis. One should also learn to acquire the habit of detecting differences in translucency or color of teeth, or teeth involved by trauma. A provisional diagnosis may often be established by a simple test such as percusion or palpation, which can then be confirmed by some other clinical or laboratory test.

In the accompanying diagnostic table (Table I) are listed the symptoms commonly found in diseases of the pulp and periapical tissues which may be found helpful in establishing a correct diagnosis. While the data are based upon observation of numerous cases over an extended period of time and are as accurate as a tabulation of human symptoms can be, variations may be expected to occur. The table is, therefore, suggestive rather than exact, so far as any individual case is concerned. A working familiarity with it should be very helpful in identifying pulp or periapical disease. Hyperemia, though strictly speaking a disturbance and not a disease of the pulp, is included in the tabulation for completeness.

TABLE II

TREATMENT OF PULPITIS

(Entire technique must be carried out aseptically under the rubber dam)

FIRST TREATMENT	SECOND TREATMENT	THIRD TREATMENT
If *pain* is present, wash cavity with warm water, remove soft decay, dry cavity, apply chloretone in oil of clove. Seal without pressure. Carry out following procedure at next visit. If *no pain* is present, anesthetize by infiltration or conduction anesthesia, open pulp chamber until direct access is obtained to canals. Remove contents of pulp chamber with excavator. Explore canal with smooth broach, follow with barbed broach to apex and remove pulp. Enlarge canals with reamers and files, using them in sequence of sizes. Irrigate canal* with sterile water. Take roentgenogram with largest size instrument that will reach to apex to make certain that all pulp tissue has been removed. Seal camphorated phenol or eugenol on absorbent point in canal.	Discard dressing from previous visit. Swab pulp chamber and surface of tooth with alcohol. Dry with sterile cotton pellets. Dry canal thoroughly with sterile paper points. Introduce a sterile paper point to apex, let remain for at least one minute, then remove and drop in tube of culture medium. Seal dressing of camphorated phenol or eugenol in canal.	If culture medium shows no growth after 48 or more hours, canal is ready for filling. If growth is present, canal should be examined with root canal instrument for traces of debris or pulp fragments. The canal is then irrigated, dried with absorbent points, and sealed with a germicidal dressing (azochloramid, beechwood creosote, camphorated monochlorphenol, or cresatin). The canal is filled only after a negative culture has been obtained.

*See Grossman, L. I.: J. Am. Dent. A. 30: 1915, 1943.

TABLE III

TREATMENT OF PERIAPICAL TISSUES

(Entire technique must be carried out aseptically under the rubber dam)

FIRST TREATMENT	SECOND TREATMENT	THIRD TREATMENT
Obtain access along straight lines and remove contents of pulp chamber. Remove pulp tissue in root canal, being careful not to instrumentate in apical region of canal. Irrigate root canal with chlorinated soda solution.* Seal chlorinated soda solution in canal on absorbent point, or dry canal and seal in germicide (azochloramid, beechwood creosote, camphorated monochlorphenol, cresatin). Apply principle of drug rotation using, in turn, 1 or another of above-mentioned germicides at each visit.	Remove dressing and enlarge canal. Irrigate alternately with chlorinated soda solution* and hydrogen peroxide, U.S.P. Dry canal and seal in germicidal dressing. If area of rarefaction is present, electrolytic medication should be used. If area of rarefaction is large, and other conditions are favorable, root amputation should be performed at next visit.	If dressing appears to be clean and odor of medicament is still present, take culture. (For procedure in taking culture, see second treatment in Table II.) If not, irrigate root canal, dry, and seal in a germicidal dressing. When condition warrants, take a culture, and when culture is negative, fill root canal.

NOTE: In acute or subacute abscess, drainage must first be established. This is accomplished via the root canal, an incision through gum down to periosteum if soft swelling is present, or both. To establish drainage via the root canal, a large enough cavity should be prepared so that the dead or decomposed pulp may be removed completely. The above-mentioned treatment in Table III is carried out only after the tooth is comfortable and the swelling has subsided.

*See Grossman, L. I.: J. Am. Dent. A. **30**: 1915, 1943.

Once having established the diagnosis, the respective treatment schedule in Tables II and III should prove to be a dependable guide in helping to carry out correct treatment based upon correct diagnosis. In *all* cases the rubber dam should be applied and the field of operation sterilized with tincture of metaphen.

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THE BACTERICIDAL ACTION OF ULTRAVIOLET RADIATION ON THE ORAL FLORA AND ITS EFFECTIVENESS FOR DENTAL BURR STERILIZATION

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VARIOUS physical agents may be used for the sterilization of dental instruments. When instruments with fine cutting edges, such as dental burrs, require sterilization, moist heat in the form of boiling water or steam is impractical and uneconomical because of its dulling and rusting action. This study deals with the effectiveness of another physical agent, ultraviolet radiation, which was generated by a small commercial unit which is marketed for use in the dental office.

It has long been known that sunlight destroys bacteria and that the bactericidal effect of solar radiation is present in the short wave length components which are present in the ultraviolet portion of the visible spectrum. Artificial ultraviolet energy can be produced by the electric arc or the mercury arc, the latter being the most convenient source of this form of energy. A small amount of ozone is formed by radiations which are below 2,000 angstrom units. Ozone itself is bacteriostatic but it will not destroy spore forms.

All rays below 3,000 Å (1 angstrom unit = 0.1 mμ) are bactericidal with a maximum bactericidal effect per unit energy occurring at approximately 2,500 Å. This wave length holds apparently for all bacterial and fungal species which have been studied. The bactericidal action of the ultraviolet is believed to result from altered chemical changes in the bacterial cell which cause its death. While a purplish violet color is produced by the ultraviolet generator, it should be emphasized that the bactericidal rays do not lie in the visible spectrum.

In general, the bacterial death rate is proportional to the intensity of the radiation, which is dependent on the distance of the object from the ultraviolet generator, the time of exposure, the type of organism which is present, and the physical state (dry, moist, or wet) of the object radiated. Since most substances do not transmit or reflect ultraviolet radiation, it is necessary for all surfaces of the object being sterilized to be exposed to the ultraviolet radiation.

Ultraviolet radiation has been extensively and successfully used for air sterilization in hospitals, schoolrooms, and auditoriums. More limited applications consist of its use for sterilization of the blood stream by means of ultraviolet radiation.

The ultraviolet generator and cabinet used in this study was one which was commercially manufactured for use in the dental office (Fig. 1). The promotion literature of this particular piece of equipment included the results of laboratory

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studies which demonstrated the bactericidal properties of ultraviolet radiation for different bacterial species. The studies reported apparently did not use the particular ultraviolet generator which was marketed for dental use nor were any studies reported which were performed under conditions which simulated those of dental practice. No data are offered by the manufacturer in respect to the life of the generator or the constancy of irradiation during the life of the generator.

Hamilton studied the effectiveness of one of these ultraviolet instrument sterilizers by exposing bacterial smears to direct and indirect (reflected) radiation for varying periods. The smears then were removed from the sterilizer and cultures were made. The positive growths were identified to insure that they were not contaminants. Hamilton concluded that even after an exposure of one and one-half hours dental instruments might not be sterilized, although no data are given about actual tests performed on dental instruments.

This present study was undertaken to determine (1) the bactericidal properties of an ultraviolet generator designed for use in the dental office, on a variety of organisms including those which are commonly found in the oral cavity, and (2) the effectiveness of this means of sterilization for dental burrs under conditions which simulate those occurring in dental practice.

METHODS AND DATA

The ultraviolet generator was turned on thirty minutes prior to exposure of the Petri dishes or dental burrs. This permitted sterilization of the air within the cabinet and allowed the generator to reach a stable operating temperature.

1. Poured blood agar Petri plates (5 per cent horse's blood) were incubated for twelve hours to assure sterility.

2. A small handle or lifting tab of Scotch tape was fastened to the lid of each Petri dish. The inoculated Petri dishes were then placed in the ultraviolet sterilizing cabinet. After three minutes' exposure to ultraviolet, the Petri dish covers were carefully removed with sterile tweezers. The covers were placed outside of the sterilizing cabinet on a towel moistened in 1:500 $HgCl_2$ solution.

3. At definite intervals of time, the lids were returned to the Petri dishes by alcohol-flamed tweezers, and the dishes were removed from the sterilizer. If the Petri dishes were allowed to remain in the sterilizer long after radiation, secondary bacteriostatic action due to exposure to ozone might occur.

4. The radiated plates and unirradiated control plates were incubated for twenty-four hours and read. Morphologic studies were made on the colonies of the positive irradiated and control plates. Negative plates were incubated for another twenty-four hours.

It was necessary to determine whether the radiation of the agar culture medium imparted any bacteriostatic properties which might act after the removal of the plate from the sterilizing cabinet. A group of six uninoculated poured agar plates was exposed to the ultraviolet radiation for thirty minutes. These plates and six unirradiated poured agar plates were inoculated with an eighteen-hour beef heart infusion broth culture of saliva. Following twenty-four hours' incubation no difference in the bacterial growth on the radiated and the unirradiated agar plates could be detected. The exposure of the agar

to the ultraviolet radiation for thirty minutes did not impart any bacteriostatic or bactericidal properties to this substance which could be detected and which would require consideration in an analysis of the data.

The bactericidal action of the ultraviolet generator was tested by exposing blood agar cough plates for five minute increments, up to and including thirty minutes' exposure. Four plates were run for each time interval and four unirradiated plates served as controls for the entire series. No growth was observed on the plates which were radiated for ten minutes and longer, although a heavy growth was noted on the control plates. This preliminary study indicated clearly that bactericidal rays were being generated in the ultraviolet sterilizing cabinet.

Fig. 1.—Ultraviolet generator used in these studies.

Eighteen-hour beef heart infusion broth cultures of various organisms and the mixed oral flora (saliva) were streaked on blood agar plates and exposed to the action of the ultraviolet radiation in a similar manner to that described for the cough plates. Since it was desirable, for the main test, to use an organism which could be readily identified by gross inspection of the cultures or plates, tests were also run with *Serratia marcescens*. All these data are shown in Table I.

Under the conditions of this experiment the ultraviolet generator was shown to be bactericidal for the usual oral flora (saliva), and pure cultures of beta streptococcus, *Staphylococcus aureus* and *albus, Escherichia coli,* and *Bacillus subtilis* including spore forms. Radiation for thirty minutes of blood agar plates streaked with eighteen-hour cultures of these organisms prevented growth. The surfaces of the inoculated plates were fully exposed to the ultraviolet radiation; they were smooth and contained no blood, mucus, or debris, and they were exposed immediately after inoculation while the inoculum was still moist: all factors which might contribute to the lack of growth following thirty minutes radiation. *Serratia marcescens* was more resistant to the ultraviolet radiation. This may have been due to a heavier initial inoculation because of more abundant

TABLE I

	5 MINUTES		10 MINUTES		15 MINUTES		20 MINUTES		25 MINUTES		30 MINUTES		CONTROLS	
	NO PLATES RADIATED	WITH GROWTH	NO PLATES RADIATED	WITH GROWTH	NO PLATES RADIATED	WITH GROWTH	NO PLATES RADIATED	WITH GROWTH	NO PLATES RADIATED	WITH GROWTH	NO PLATES RADIATED	WITH GROWTH	NO PLATES RADIATED	WITH GROWTH
Mixed oral flora (saliva)	8	7	8	3	8	0	8	0	8	0	8	0	4	4
Beta streptococci	16	0	16	0	16	0	16	0	16	0	16	0	4	4
Staphylococcus aureus	16	2	16	1	16	0	16	0	16	0	16	0	4	4
Staphylococcus albus	4	0	4	0	4	0	4	0	4	0	4	0	4	4
Escherichia coli	8	4	8	4	8	0	8	0	8	0	8	0	4	4
Bacillus subtilis with spores*	8	7	8	4	8	0	8	4	8	0	8	0	4*	4
Cough plates	4	2	4	1	4	0	4	0	4	0	4	0	4	4
Serratia marcescens	16	15	16	12	16	12	16	2	16	4	16	1	4	4

*Numerous spores seen in smears of 6-day-old culture which was used.

growth of this organism or to the fact that bacterial growth took place at the temperature existing in the ultraviolet generator—about 27° C.

TECHNIQUE OF BURR STERILIZATION STUDIES

The preliminary study of burr sterilization was made on used dental burrs obtained at random from the Operative Clinic.

1. The burrs were cleaned physically with the usual wire scratch brush, after which the cutting head of the burr, including 2 to 3 mm. of the shank, was dipped and rotated in a suspension composed of 5 c.c. of paraffin-stimulated saliva and 1 c.c. of an eighteen-hour beef heart infusion broth culture of *Serratia marcescens.* The burrs were placed in the burr holder of the ultraviolet radiator and allowed to dry outside the sterilizing cabinet. They were then "cleaned" again with a second scratch brush.

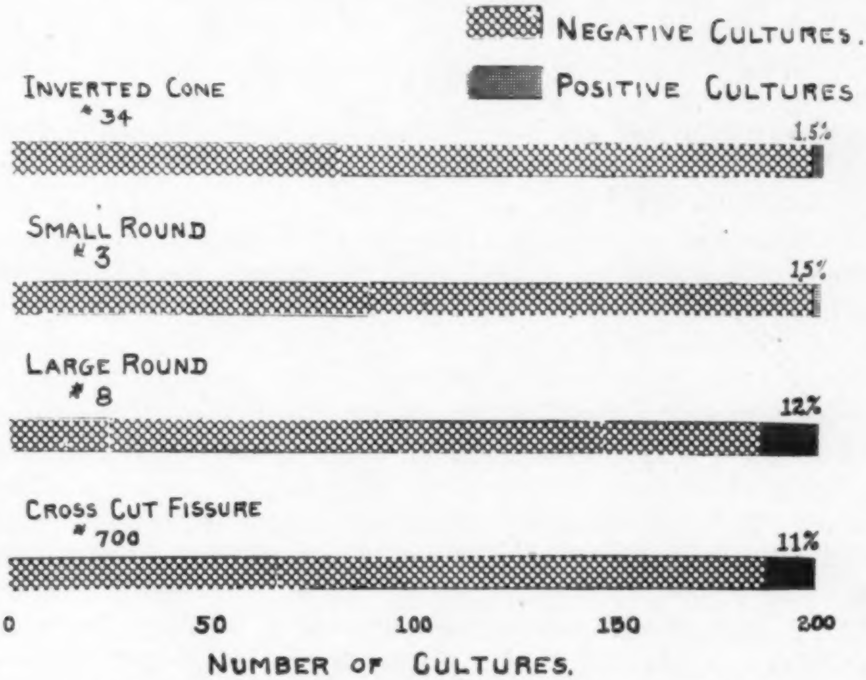

Fig. 2.—Ultraviolet radiation for the sterilization of dental burrs.

2. By means of hemostatic forceps dipped in alcohol and flamed three times, the cutting head, including 2 to 3 mm. of the shank of each burr, was dipped in a tube of beef heart infusion broth and again placed in the burr holder and allowed to dry.

3. The burr holder with the contained burrs was then placed in the ultraviolet sterilizer for thirty minutes. At the conclusion of the radiation, the cutting head, including 2 to 3 mm. of the shank of each burr, was dipped into a second tube of beef heart infusion broth by means of hemostatic forceps dipped in alcohol and thrice flamed.

4. Four similarly treated unirradiated burrs, which were also dipped into two tubes of beef heart infusion broth, served as controls.

5. The inoculated media were incubated for twenty-four hours at 37° C. Transfers were made from all macroscopically negative tubes to poured agar

plates and incubated twenty-four hours. Morphologic studies were made on all positive cultures.

From a preliminary study of 100 dental burrs of varying sizes and types, it was noted that the positive cultural results were associated with (1) certain types of dental burrs, and (2) the position of the burr in the burr holder in respect to the ultraviolet generator. The amount of direct and reflected radiation reaching the burrs in the upper half of the burr holder was greater than that in the lower half.

From this pilot experiment it was decided to rotate the burr holder 180 degrees at the end of fifteen minutes and to run tests using one type of burr at a time.

The main study of the effectiveness of this particular ultraviolet generator for dental burr sterilization consisted of 200 cultures of each of the following types of burrs: No. 34 inverted cone, Nos. 3 and 8 round, and No. 700 crosscut fissure burrs. Only three positive cultures were obtained from each of the 200 inverted cone (No. 34) and small round (No. 8) burrs studied. Twenty-four positive cultures were obtained from the 200 large round burrs and 22 positive cultures were obtained from the 200 crosscut fissure burrs. These data are presented in Fig. 2.

The number of positive cultures increased with the increase in size and the complexity of design of the dental burr. This suggests that all the surfaces of the larger and more complex burrs do not receive an adequate intensity of radiation for effective sterilization.

SUMMARY

A small ultraviolet generator which was designed for use in the dental office was shown to be bactericidal for the oral flora (saliva) and other organisms when eighteen-hour broth cultures were streaked on the surface of blood agar plates and exposed to the ultraviolet generator for thirty minutes. The bactericidal action was not due to the prolonged radiation of the agar culture media.

The ultraviolet generator was more effective in sterilizing burrs of small size and simple design than those of greater size and complexity. Under conditions simulating those of clinical practice, complete sterilization of even the small burrs of simple design was not obtained after thirty minutes radiation.

Improvements in design of the ultraviolet generator, the sterilizing cabinet, and the burr holder may result in a more efficient instrument which would be practical for the sterilization of dental burrs.

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THE ORAL MANIFESTATIONS OF ERYTHROBLASTIC (COOLEY'S) ANEMIA

Case Report

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ERYTHROBLASTIC anemia is a severe and usually fatal anemia of childhood. It is essentially a hereditary[4, 5] chronic disease of Mediterranean races (Greek, Armenian, Italian, and Sicilian).[6, 7] It is characterized by leucocytosis, evidence of bone marrow stimulation, absence of increased fragility of the red blood cells, splenomegaly, osteoporosis, a peculiar mongoloid facial appearance,[2] and a prominent premaxilla with well-developed anterior teeth.

Symptoms of this disease appear in infancy as early as the second month, and it terminates usually in death within a few years. There are all gradations from this acute form to those cases in which there may be little or no anemia, fever, or positive physical manifestations. In many instances the only stigma of the disease is an increased number of nucleated cells in the circulating blood and an abnormal resistance of these cells and all red blood cells to hemolysis. This phase of the disease is not incompatible with life, but the patients frequently complain of malaise and lack of strength. Episodes of anemia, increased weakness, chills and fever, and susceptibility to intercurrent infection are commonly observed. The clinical picture is characterized by a continuous fever which is frequently associated with chills, and enlargement of the liver. The skin is icteric.

The blood picture is usually characterized by a severe, erythroblastic type of anemia with hypochromic anemia of varying degrees. Polychromatophilia, stippled and "target cells," polycythemia, reticulocytes, macrocytes, and occasionally normoblasts are found in the circulating blood. The red blood cells possess an abnormally increased resistance to hemolysis and there is a considerable degree of anisocytosis, and poikilocytosis. The icteric index is elevated.

The bone changes, which have been described in detail by Koch and Shapiro,[3] may occur in the early stages, but they are almost invariably present in the advanced stages of the disease. These osseous changes consist of a mongoloid facies with high malar eminences, a short nose, and large prominent flaring upper teeth, which may prevent closure of the lips. The development of the mandible is compatible with the age of the patient. The incisal edges of the teeth have definite enamel tubercles, due probably to the marked overjet of the anterior teeth which prevents their wear. There is also a peculiar yellow color to the skin, and an enlarged head with prominent veins, and frontal bosses.

Osteoporosis can be demonstrated in the long bones and skull by x-ray examination, and, as the condition progresses, it is gradually altered by the appearance of a compensatory lamellar striations which tend to replace the mar-

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row. There is extensive thickening and widening of the cranial and malar bones. The flat bones of the skull show medullary thickening, radial striations, and the tables are usually thin. In continuously stimulated hematopoiesis, the marrow in the bones of the skull can expand only outward; therefore, the trabeculae connecting the two plates are elongated, which produces a bristlelike roentgenologic appearance. If, on the other hand, the process becomes arrested, calcification takes place with formation of transverse trabeculae. Therefore, the thickened diploë and the honeycombed or "pepper and salt" appearance, sometimes seen on the x-ray, may indicate an abnormally stimulated hematopoiesis from which the individual may have recovered in infancy.

An effective treatment has not been found. Iron and liver therapy are of no value. Splenectomy tends to increase the anemia and is therefore contraindicated.[5] Transfusions are only palliative. The disease runs a chronic course and progresses slowly to a fatal termination. In a group of twenty-three cases reported by Koch and Shapiro,[3] the shortest course of the disease was fifteen months, and the longest duration was ten years. Death results generally from cardiac decompensation, secondary infection, or the development of a hemorrhagic type of thrombopenic purpura.

CASE REPORT

E. S., a white girl 3 years of age, was admitted to the Children's Hospital of Philadelphia, Oct. 14, 1928, complaining of pallor, and a yellow appearance of the skin of nine months' duration. She had an attack of jaundice, with loss of appetite, in June, 1928, at which time she was kept in bed; she recovered apparently in two or three weeks. Since then she has had a progressive anemia and, two weeks before admission, developed a slight cold accompanied by fever, headache, and "black urine." The patient became paler, weaker, and more yellow in color four days after the onset of the fever. A diagnosis of erythroblastic anemia was reached after complete studies had been made.

This poorly developed and poorly nourished patient was admitted for the ninth time, in August, 1943. She was a listless, anemic, inactive, undernourished, potbellied, little girl, with a peculiar mongoloid facies. Hepatosplenomegaly, a bilateral cervical adenopathy which was neither hard nor tender, and dental caries were present. The skin had a peculiar lemon yellow pallor, otherwise it was clear. No abnormalities were present in the ears, nose, or throat.

Prominent veins could be seen over the temporal region of the head. There were disproportionally large malar eminences and protruding upper jaw. (Fig. 1.) The tapering maxillary incisors were in a marked labial version, with prominent enamel developmental lobes on the incisal edges. (Fig. 2.) They had the general appearance of being large in length and width, which is characteristic of this disease in spite of the young age of the patient. The mandibular teeth had the same prominent incisal markings. The first incisor was further advanced in its development than the second incisor. (Fig. 3.) Large cavities were present in the lower left first and second deciduous molars, necessitating extractions. The remaining teeth were compatible with her age in development. The blanched gingivae were not excessively hypertrophied and did not bleed readily. The tongue presented white patches having the general appearance

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Fig. 1.—Patient with erythroblastic anemia showing characteristic facial deformity.

of a wandering rash or geographic tongue. Her lips normally did not cover the incisors. This could only be done when a special attempt was made to do so. A marked fetor exore existed. The laboratory data (May 19, 1943) revealed negative urinary findings and a negative Mantoux test using O.T. 1:1,000; red blood cells, 2,540,000 per cubic millimeter; white blood cells, 10,100 per cubic millimeter; hemoglobin, 5.4 Gm. per 100 c.c.; nucleated red blood cells 15 per cent. The differential count was: neutrophiles, 51 per cent; eosinophiles, 2 per cent; basophiles, 1 per cent; lymphocytes, 42 per cent; the urea clearance test, the phenolsulfonphthalein test, and blood urea nitrogen, were all within normal limits.

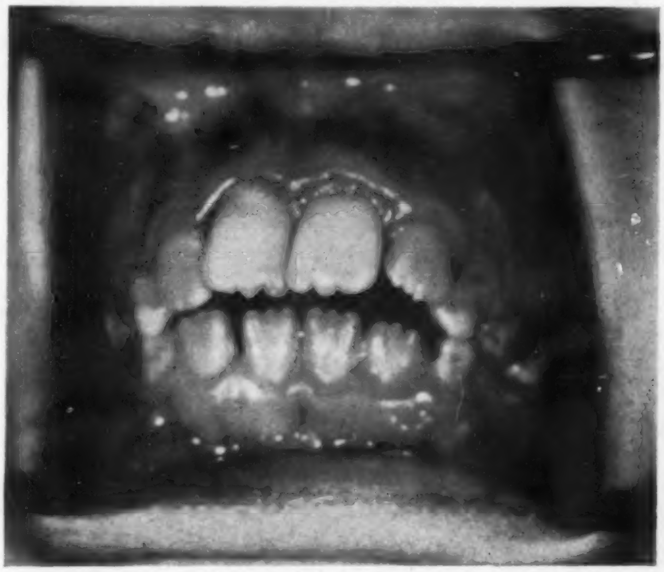

Fig. 2.—Open-bite. Prominent enamel tubercles on the incisal edges.

Fig. 3.—Normal lip line. Note overdevelopment of first incisor.

Roentgenologic findings of the long bones revealed demineralization and prominent trabeculations of bone. The skull presented a typical bristlelike appearance of the calvarium. (Fig. 4.) The teeth and jaws revealed no evi-

Fig. 4.—Skull presenting a typical bristlelike appearance of the calvarium.

Fig. 5.

Fig. 6.

Figs. 5 and 6.—Teeth and jaws revealing a normal complement, compatible with the age of the patient.

dences of periapical infection, but a normal complement, compatible with the age of the patient. (Figs. 5 and 6.) The osseous structures of the maxilla and mandible revealed no other changes than prominent trabeculations.

Prior to the ninth admission, the patient was seen at the dental clinic, at which time several teeth had to be extracted. A hemoglobin content of blood, 5.5 Gm. per 100 c.c., and the patient's systemic condition necessitated admittance in August, 1943, for special treatment and further transfusions prior to oral or dental surgery. The hemoglobin had risen to 8 Gm. per 100 c.c. by September 13, at which time the left mandibular first and second deciduous molars were extracted. These teeth were loose, and had retarded the eruption of the permanent successors. There were no postoperative complications and the patient was discharged to the care of the outpatient department, Sept. 16, 1943.

COMMENT

The parents of this little girl were both of Italian extraction, having three children in all. A younger sister, 3 years of age, with the same condition has a similar case history and a brother, 6 years of age, is apparently free of symptoms. The patient developed a mild upper respiratory infection, which necessitated admitting her ten days later. Her hemoglobin at this time was 5 Gm. per 100 c.c., which required additional blood transfusions.

In the several cases (five) observed in different families at the Children's Hospital, it was noted that this condition affected the males as well as the females. In one family a boy was striken with the disease and lived to 10 years of age, having a brother, 7 years of age, with the same condition, and a sister, 21 years of age, who is normal.

SUMMARY

A single report of this condition is to be found in dental literature.* This case illustrates the importance of roentgenograms and blood studies in making a diagnosis, because the presence of a local sign in the mouth may often be due to a disease of the blood.

Grateful acknowledgement is made to Dr. Joseph Stokes, Jr., for permission to report this case.

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ORAL ASPECTS OF PAGET'S DISEASE, INCLUDING CASE REPORTS AND NECROPSY FINDINGS

ALTON J. NOVAK, B.S. IN PHAR., D.D.S., AND
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PAGET'S disease is a chronic bone dystrophy usually beginning in middle life. It occurs in either of two forms: (1) a disseminated form in which many bones are involved either simultaneously or progressively, i.e., the long bones, the bones of the pelvis, the spinal column, or the cranium, and (2) a localized form, in which the clinical changes are limited to a single bone, i.e., usually the tibia (Bell[1]). Whether the latter form represents an early stage of the disseminated condition, or whether it may be associated with microscopic changes in other bones that escape clinical detection, is open to question.

It has been estimated that approximately 500 cases of disseminated Paget's disease have been reported up to 1933.[9] The incidence of Paget's disease of bone varies from one in 10,000 admissions at Johns Hopkins Hospital to one in 16,000 at the Mayo Clinic. Paget's disease was present in 138 of the 4,614 patients studied by Schmorl.[23] Sutherland[26] reports having seen Paget's disease in twenty out of 15,000 roentgenograms of the lumbar spine and pelvis. Generalized Paget's disease is a rare condition. The clinical changes produced in the face are uncommon and many times the microscopic changes are the only evidence of Paget's disease. Cook[5] reported the first case of Paget's disease from the Oral Diagnosis Clinic of the School of Dentistry, University of Pennsylvania, in 1935. Since then three additional cases have been noted in approximately 50,000 new admittances.

The percentage frequency of the parts affected is as follows: sacrum, 56 per cent; spine, 50 per cent; femur, 31 per cent; skull, 28 per cent; sternum, 23 per cent; and pelvis, 21 per cent.[12] Da Costa[6] has stated that a characteristic feature of the disease is the enlargement of the skull, but the face is seldom affected below the supraorbital margins. Numerous case reports have appeared in which the maxilla[2, 3, 8, 17, 19, 22, 27] or the mandible[9, 24] have been involved. Jaw roentgenograms in 138 cases of generalized Paget's disease revealed involvement of the maxilla in twenty cases, and of the mandible in three cases.[25] Deppe[7] cited a case where the zygomata and jawbones were very much thickened.

Many who have studied this disease consider the exact causative agent to be unknown. No hereditary tendency was found in the series of cases studied by Paget. In twenty-two of Kerr's American cases there was an hereditary element.[14] Da Costa[6] mentioned four instances in which other members of the

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same family were affected. Miller[18] reported the occurrence of an osteodystrophy apparently of a similar nature in several members of the same family. Knaggs[16] states that Paget's disease, osteitis fibrosa, and osteomalacia, are merely different reactions to some metabolic toxin. This view rather than an infectious disorder is held by Rabinowitch.[21] Thoma[28] has called attention to the differentiation of Paget's disease from fibro-osteoma.

Cahn[4] and others[26] have compared acromegaly with osteitis deformans and pointed out that in the latter disease the calvarium enlarges first, giving the face a triangular appearance with the chin forming the apex of the triangle. The jaws are next to become involved and the face has a gross leontine appearance. In acromegaly the jaw enlargement is chiefly confined to the mandible. Wilhelm[29] differentiates between syphilis and osteitis deformans in that there is a marked participation of the periosteum in syphilis and in Paget's disease there is no participation of the periosteum. In syphilis there is a narrowing and obliteration of the marrow cavity, and newly formed bone has a sclerotic or finely porous quality, while in Paget's disease a widening of the marrow cavity takes place, and new bone shows a lengthwise splitting into lamellae.

Kirshbaum[15] described a case of sarcoma of the skull associated with Paget's disease, and he suggested that every case of sarcoma of the skull be investigated for the coexistence of Paget's disease. Grizaud[10] has discussed the question of trauma as an etiological factor for sarcomatous transformations in cases of Paget's disease.

Kay[13] has noted that when the lesions involve a large portion of the skeleton there is a rise in the blood plasma phosphatase varying from four to twenty times normal. This phosphatase rise is not specific for Paget's disease since similar high values have been noted in osteitis fibrosa cystica and in rickets.

CLINICAL FEATURES OF THE DISEASE

The clinical picture of this disease as described by Paget[20] included a bowing of the lower extremities which is produced when the softened long bones yield to the body weight, a marked diffuse enlargement of the skull, a reduction in the height which accompanies the accentuated dorsal and lumbar curvatures of the spine, and a widening of the pelvis. This typical picture is seen only in the disseminated form of the disease.[11]

The characteristic oral findings in this disease are mainly objective. There is an enlargement of the maxilla with a marked widening of the alveolar ridges. The mandible is rarely involved. The occlusion is usually within normal limits but there is a tendency for the teeth to drift and separate in the area of bone involvement. The overdevelopment of the upper portion of the face gives the appearance of more marked alteration of the occlusal relations. Not infrequently the teeth become loosened due to changes in the supporting tissues. Gross[*] states that he is hesitant to perform extractions on patients with Paget's disease because of the danger of osteomyelitis developing.

In patients wearing dentures there is the need for frequent denture servicing to compensate for the change in size of the alveolar ridges. The repeated

*Personal communication.

breaking of an otherwise satisfactory denture has been the first evidence of the continuous change in the anatomy of the maxilla. The mucosa covering the enlarged ridges has a tense, stretched appearance.

ROENTGENOLOGIC CHANGES

There appears to be an increased radiopacity to the teeth. This is actually due to the marked contrast between the teeth and the radiolucent alveolar process. Roentgenograms of the jaws, particularly the maxilla, reveal the irregular areas of increased radiopacity and radiolucency of "cotton wool appearance" which are so characteristic of this disease. There is a generalized loss of the normal bone trabeculation. Hypercementoses of one or more of the teeth in the affected region is frequently observed.[25]

DIAGNOSIS

The diagnosis of the disseminated form of this disease may be made on the basis of the characteristic clinical features. The localized forms of the disease are frequently first detected by accidental roentgenologic findings. In the case of oral lesions which present suggestive clinical and roentgenologic findings a biopsy examination and other laboratory procedures are indicated to establish the diagnosis.

CASE REPORTS

CASE 1.—Mrs. E. D., a Negro woman, 58 years old, came to the School of Dentistry on May 7, 1943, for the diagnosis and treatment of pain and a foul discharge about the left maxillary premolar region. She had seen her dentist for the extraction of the maxillary left first premolar and left mandibular first premolar on March 14, 1943. The pain started three days later and it has persisted since that time. It was located in the left maxillary premolar region and was of a sharp constant nature, radiating to the parietal region of the same side. The pain became more severe at night and prevented normal rest. The weight dropped from 170 to 95 pounds after the onset of the pain six weeks before (according to the patient). The home treatment consisted of flaxseed and onion poultice to the affected side.

The patient's past medical and family history were irrelevant. Her Kolmer reaction was negative. Other common laboratory studies were within the normal range of values except for a moderate anemia.

Physical Examination.—The positive findings were confined essentially to the head and neck region. The forehead was sloping and rather small in size, but the supraciliary ridges were prominent. The general facial development was not unusual although the malar bones and superior maxilla appeared to be larger than normal. The marked overgrowth in the size and contour of the alveolar ridges were the outstanding findings. They gave to the mouth the appearance of having a high narrow palatal vault.

The alveolar ridges extended almost to the midline of the palate in the anterior region, and occupied posteriorly about one-third of this structure. The maxillary tuberosities were huge. The alveolar ridges had an average width of 2 cm. (Fig. 1). There were seven teeth present in the maxilla. On the right side there was an ill-fitting fixed gold bridge with the right canine and the first

molar serving as abutments. Six teeth were present in the mandible—all in need of dental attention. This marked overgrowth of the alveolar ridges in the upper jaw was the most striking finding on clinical examination.

The left maxillary region was of particular interest. The left maxillary alveolar ridge in the premolar area was extremely painful to touch and a foul yellowish discharge exuded from a craterlike depression which bisected the long axis of the alveolar ridge. The mucosa covering the alveolar ridge appeared blanched but it presented no visible areas of necrosis or ulceration.

No abnormalities were observed in the buccal mucosa or gingivae or the tongue. The left submaxillary lymph nodes and the parotid gland were enlarged but not painful.

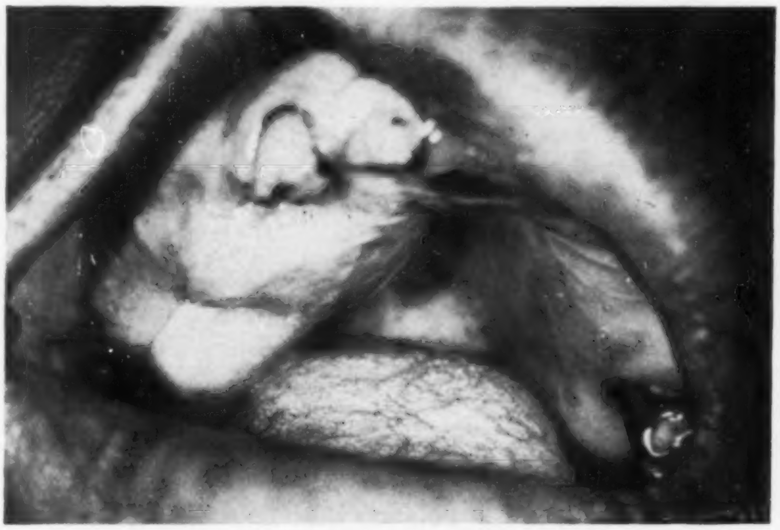

Fig. 1.—Case 1. Showing the marked increase in size of the alveolar ridges. Craterlike depression can be seen in the right premolar region. This was the site of the foul discharge.

Fig. 2.—Case 1. Showing loss of trabecular detail in the right upper premolar region and "cotton wool" appearance of the bone.

Roentgenologic Findings.—A periapical film of the left maxillary premolar region revealed a loss of trabecular detail, and local areas of increased density of the bone which presented the "cotton wool" appearance (Fig. 2). Further roentgenologic study revealed that the maxilla was completely involved, while the mandible was partially involved (Figs. 3 and 4). Roentgenologic studies of the skull did not show the typical "cotton wool" appearance, but there was an enormous thickening of the calvarium.

A biopsy specimen was secured for study by John H. Gunter of the Oral Surgery Department, on May 27, 1943. The pathologist reported that the tis-

sue removed showed predominant osteogenic signs, the bone formation far outweighing the bone destruction. The bone was of an osteoid nature and mosaic designs were found which were characteristic of osteitis deformans.

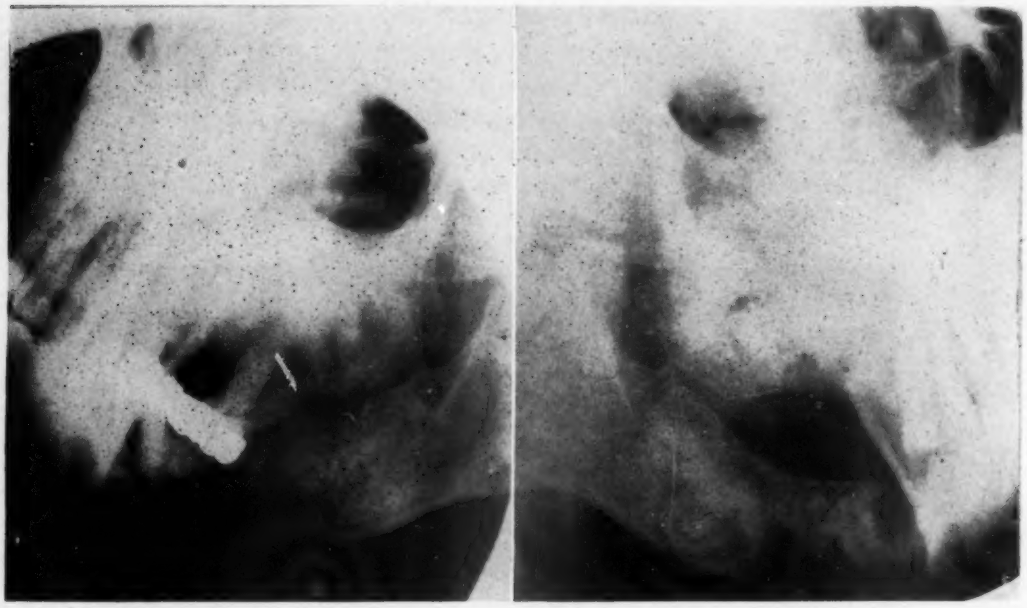

Fig. 3.—Case 1. Revealing the entire maxilla to be involved with partial involvement of the mandible.

Fig. 4.—Case 1. Occlusal view of maxilla.

Case 2.—A. S., a Negro woman, 48 years old, came to the School of Dentistry on Sept. 10, 1943, for the diagnosis and treatment of pain in the left mandibular molar region. The positive findings were confined essentially to the head and neck areas.

This patient's forehead was sloping and rather small in size but the supraciliary ridges were prominent. There was a marked increase in the width and size of thé alveolar ridges of the edentulous maxilla. This change was particularly prominent in the region of the tuberosities. Three anterior mandibular incisors were present. They presented no evidence of periodontal or periapical infection. On examination, the mandible appeared moderately thickened. There were no abnormal clinical findings in the lower left molar region, which was the location of the painful symptoms. No abnormalities of the buccal mucosa or tongue were noted.

Roentgenologic Findings.—A periapical film of the left mandibular premolar region revealed a "cotton wool" appearance (Fig. 5). Further roentgenologic study revealed that the entire maxilla was involved in a similar process. Roentgenologic studies of the skull revealed an enormous thickening of the calvarium but the typical cotton wool appearance was absent. A biopsy study removed on Sept. 13, 1943, verified the clinical impression of Paget's disease.

Fig. 5.—Case 2. Periapical film of the left mandibular premolar region revealed a "cotton wool" appearance.

Case 3.—Mrs. J. T., a Negro woman, 58 years old, came to the School of Dentistry May 25, 1944, for the restoration of her maxillary right first and second incisors. The patient's past medical and family history were irrelevant. Her Wassermann reaction was negative. Other common laboratory studies were within the normal range of values.

Physical Examination.—The marked increase in the width and size of the alveolar ridges usually seen in these cases was notably lacking and confined only to the right maxillary molar region. The patient's head with sloping forehead and prominent supraciliary ridges and tapering chin were a characteristic finding.

The patient had had an extraction nine years before, and a pain had developed in the lower left mandibular region, which annoyed her occasionally. She had a full complement of teeth in the maxilla except for a missing right molar. In the mandible she had teeth from the left canine to the right second premolar. The rest had been extracted previously. They presented no evidence of periodontal or periapical infection. No abnormalities were observed in the buccal mucosa or gingivae or tongue.

Roentgenologic Examination.—Roentgenograms revealed the characteristic osseous changes which are associated with this disease in the lower anterior and right molar region, as well as in the right maxillary molar region (Fig. 6), and

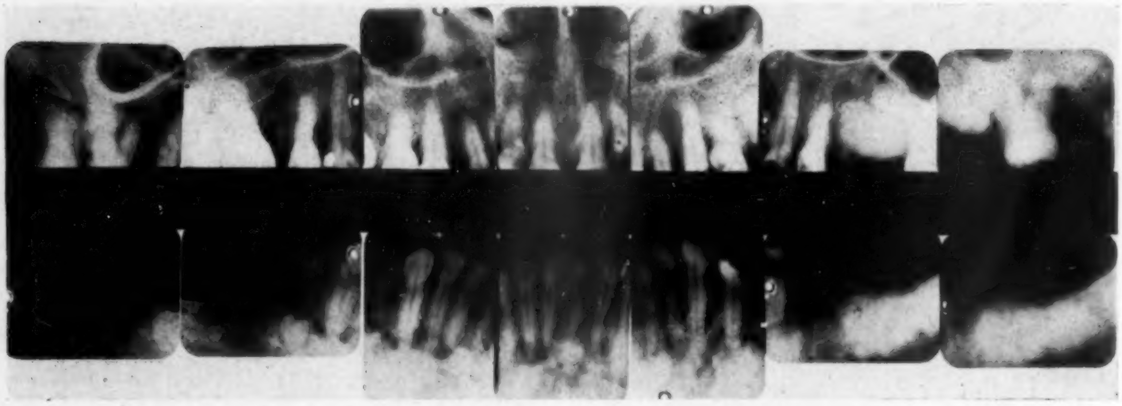

Fig. 6.—Case 3. Characteristic osseous changes associated with this disease revealed in a full-mouth roentgenogram.

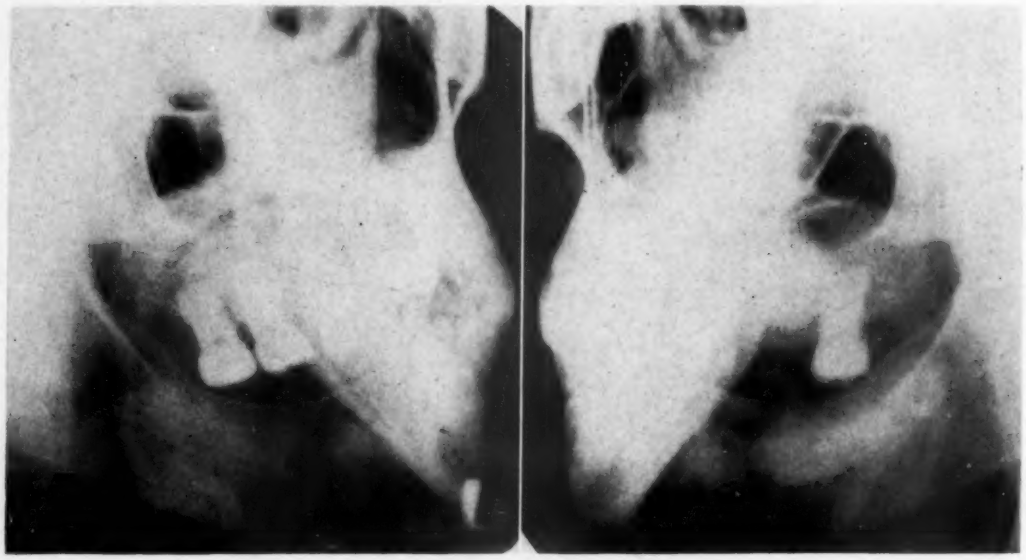

Fig. 7.—Case 3. Lateral plates.

Fig. 8.—Case 3. Skull roentgenogram showing an enormous thickening of the calvarium, with a typical "cotton wool" appearance.

slightly in the lower left posterior region (Fig. 7). The roentgenogram of the skull revealed an enormous thickening of the calvarium, with a typical "cotton wool" appearance (Fig. 8).

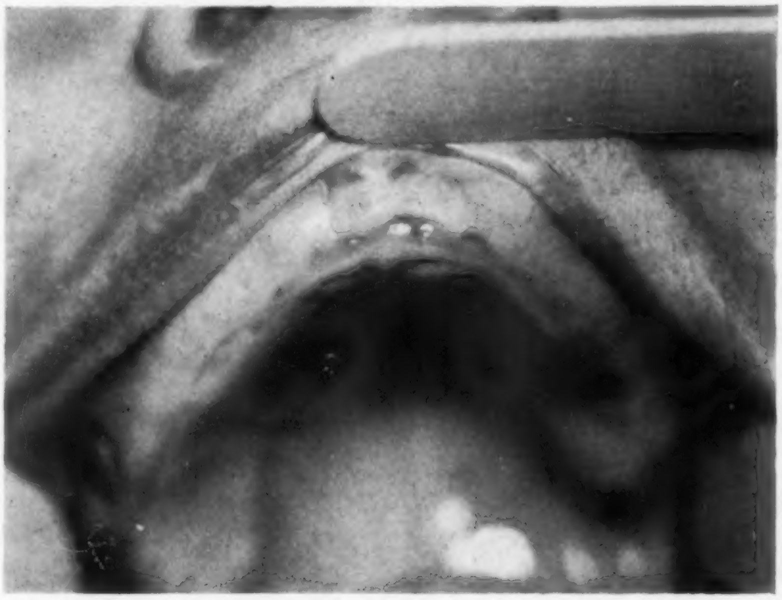

Fig. 9.—Case 4. Widening of alveolar ridges in Paget's disease.

Fig. 10.—Case 4. Facial configuration in Paget's disease.

CASE 4.—This patient, a white woman, aged 62 years, came to the Dental Clinic of the New Haven Hospital in 1935 for the removal of two remaining mandibular teeth. At this time the marked widening and increase in size of

both the maxillary and mandibular ridges were noted (Fig. 9). There was a marked overdevelopment of the entire upper third of the face which gave it an inverted pyramid configuration (Fig. 10).

Roentgenograms revealed the characteristic osseous changes which are associated with this disease. They were most marked in the maxillary tuberosities. The calvarium was markedly thickened but presented no other abnormalities. There were no observable roentgenographic changes in the pelvis. The clinical impression was verified by biopsy studies.

CASE 5.—The patient, a white male, aged 64 years, was admitted to the New Haven Hospital on Dec. 19, 1932. For the past six or seven years he had complained of pain in the lower back region. The pain became so severe that he could not walk or lie down with comfort. Three weeks before admission tender lumps were noted on the head, and a week later he experienced pain in the left leg and right shoulder. Three days before admission pain was experienced around the right eye. The patient was advised by his physician to enter the hospital because of a rare bone disease.

The essential physical findings were several small round firm masses varying from a few millimeters to 1 cm. in diameter, which were located in the right frontal and temporal regions. These were fixed to the skull and were slightly tender. The tongue deviated to the right. No exostoses were found in the bones of the lower extremities. No detailed oral examination was made during the patient's clinical course.

Laboratory Findings.—The Bence-Jones protein test was negative. Serum calcium, phosphorus, albumin, and globulin were all above normal range of values. The Kahn and Wassermann reactions were negative. The blood picture was typical of a secondary anemia.

The x-ray findings on admission were interpreted as being consistent with a diagnosis of Paget's disease (Figs. 11 and 12). The changes in the skull and the pelvis were typical of this disease.

Post-Mortem Findings. Anatomic Diagnosis.—Nodular thickening, thinning and decalcification of the bones of the skull, orbital plate, femur, tibia, clavicles, scapulae, vertebrae, and pelvis consistent with Paget's disease.

Oral Pathologic Findings.—At necropsy, two specimens of the jaws were obtained for study, consisting of that portion of the left maxilla containing the first and second incisors and canine teeth, and that portion of the left mandible containing the first and second incisors, the canine, and first premolar teeth. The specimens were removed without difficulty due to the softness of the demineralized investing bones. Hand pressure on the chisel was all that was required. The mandible was accidentally fractured in removing the block for study.

All the teeth were freely mobile although the place of attachment of the soft tissues was not unusual for the age of the subject. There were numerous fillings and cavities in the various teeth.

Dental Roentgenologic Findings.—There was a marked contrast between the radiopacity of the teeth and the decreased density of the alveolar bone which tended to accentuate the former structures. The interseptal alveolar crests were

markedly flattened and in many instances their exact margin could not be determined. The dental periosteal space was unusually widened particularly in the apical third. The lamina dura was irregular about some of the teeth and

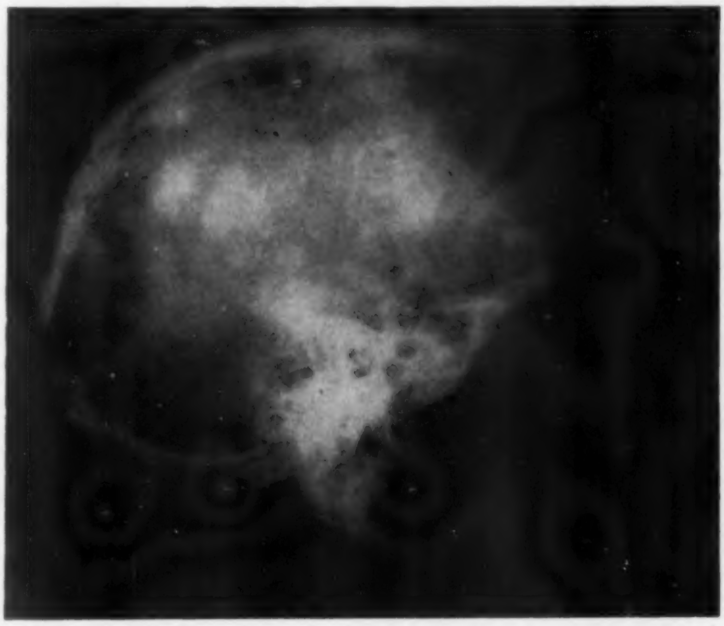

Fig. 11.—Case 5. Skull changes in patient in generalized Paget's disease.

Fig. 12.—Case 5. Pelvic changes in patient with generalized Paget's disease.

entirely missing about others. A large periapical localized radiolucent area was observed about the root of the upper left canine tooth.

Histologic Findings.—The pertinent histologic findings were confined to the alveolar bone, cementum, dentine, and pulp. The alveolar crests were mark-

edly irregular and scalloped. Numerous large multinucleated cells were observed in these lacunar defects. The compact layer of the alveolar bone surrounding the tooth (lamina dura) was irregular. It contained numerous large lacunar defects in which multinucleated cells could be observed (Fig. 13).

About the apex of the teeth, other than the maxillary canine, numerous deep blue-staining lines were observed in the alveolar bone, which were roughly parallel to the root surface. Near the alveolar crests, this compact layer of bone was frequently entirely lacking. Some of the marrow spaces also had marked scalloping of their borders in which multinucleated cells were observed.

The dental periosteum was markedly widened and irregular in width, corresponding to those areas where the most extensive changes were observed in the alveolar bone. Adjacent to the alveolar bone and the cementum were numerous large, conspicuous multinucleated cells. The dental periosteum was widest at the apex where the resorptive process was marked in both the cementum and the alveolar bone.

Fig. 13.—Lacunar defect in lamina dura with multinucleated giant cells.

No unusual findings were observed in the dentine which were not in keeping with the subject's age and the presence of cavities. There were no changes in architecture or staining characteristics of this tissue which would suggest the removal of calcium salts. No evidence of internal resorption in the dentine was noted in any of the serial sections.

Marked dystrophic changes were observed in the pulpal tissue. This tissue was composed for the most part of deep pink-staining fibrous connective tissue which contained numerous large branching vascular channels. The numerical frequency and size of the pulpal calcifications present in the teeth were unusual. Lacunar defects or differences in staining characteristics of these nodular and diffuse calcareous masses which might suggest demineralization of these structures were not noted.

SUMMARY

The present etiological and pathologic knowledge of Paget's disease is summarized. It has been pointed out that biopsy studies are indicated as an aid to diagnosis in order to be able to differentiate Paget's disease from osteitis fibrosa, as both conditions may produce similar clinical and roentgenologic findings, especially when clinical changes are noted in the mandible. X-rays of the skull and, at times, of the long bones are necessary to establish a diagnosis.

Five case reports are added of patients with oral changes in this disease; these include necropsy findings of the jaws.

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BONE CHANGES IN LEUCEMIA

I. B. Bender, D.D.S.

Many cases of various types of leucemia with certain unusual clinical and oral manifestations have been reported. Leucemias displaying extensive bone changes are rather uncommon. Craver and Copeland,[2] in reviewing 86 cases of lymphatic leucemia, found six patients with bone changes roentgenographically. The order of frequency were femur, humerus, pelvis, skull, metacarpals, ulna, and vertebrae. In a series of 82 cases of the myelogenous type, only one had associated bone changes. Bone changes in monocytic leucemia are also rare. Kositehek[4] claimed to have reported the first case, but no mention was made of the mandible, maxilla, or intraoral findings. Osgood,[5] in reviewing 133 cases of monocytic leucemia, made no mention of bone changes. Forkner,[6] in presenting six cases of monocytic leucemia, mentioned one case in which teeth were x-rayed with negative findings. Nathan,[7] reporting a case of lymphatic leucemia, found no gross bone pathosis in intraoral and lateral jaw films. Goldman[8] reported a case of acute aleucemic leucemia, showing x-rays of teeth taken post mortem that are not adequately described. Straith[9] found no evidence of bone changes in x-raying the mandible in a case of monocytic leucemia.

The following case is of particular interest because of its extensive bone dysplasia, especially in the mandible and maxilla, and an unusual facies.

CASE HISTORY

A boy, aged 12 years, was admitted to the Jewish Hospital, Philadelphia, on Dec. 4, 1940, complaining of swelling all over the body of one week's duration and swelling of the face of four weeks' duration. The child was apparently in good health until approximately three to four weeks ago when his father noticed a swelling of the face. This was first discovered on the forehead just above the nose and it was progressive up to the present time. The mouth, which was previously held closed, is now gaping and open. The nose appears distorted and broadened and the entire face is pudgy. His relatives noticed other changes in the boy. He was formerly bright and alert, but during the last few weeks he has become lethargic and slow in his reactions. He now has a peculiar manner of speech which is low and difficult to understand.

About two weeks prior to admission, the patient developed an upper respiratory infection, with sore throat, hoarseness, cough, expectoration, and elevated temperature. He went to his physician and was treated for his cough.

One week ago the patient first noticed a rash on the flexor surface of the forearms which consisted of small reddish papules. The next day the patient noticed bumps on his scalp. This alarmed him and he went to his physician, who suggested hospitalization. In the receiving ward, the patient noticed a rash covering his entire trunk, similar to that on the forearms and the back and front of the legs.

From the Department of Oral Diagnosis, Thomas W. Evans Museum and Dental Institute, School of Dentistry, University of Pennsylvania.

Physical Examination.—The patient was a well-developed, well-nourished white boy and did not appear acutely ill. The face was peculiarly edematous and pudgy, and the bridge of the nose appeared flattened. The facial features were distorted because of an apparent edema. (Fig. 1.) His eyes were small and the lids appeared swollen. Vision was good. Pupils reacted to light and accommodation. Extraocular movements were full and equal. The conjunctivae were red and injected. The hair was soft and of good quality. The scalp was clean, with small cutaneous nodules varying in size. These appeared firm, but were movable, and were imbedded in the subcutaneous tissue. The mucous membrane of the nose appeared normal and there was no discharge. There

Fig. 1.—Note the swelling in the region of the glabella and puffiness around the eyes, due to leucemic cell infiltration.

was a slight obstruction to breathing, and the nares appeared dilated. The face was swollen and hard but showed no pitting on pressure. The mouth was held wide open and gaping. The gums were swollen and bleeding. The tongue was clean, slightly swollen, and protruded in the midline. The tonsils had been removed. There was a small amount of purulent mucoid material in the post-pharyngeal wall. There was an enlargement of almost all of the lymph nodes in the neck. These were small and were not tender. The lungs were normal and equal in expansion. Percussion note was resonant throughout, and breath sounds were vesicular. There was a systolic basal murmur of the heart in the fifth interspace. The liver edge was palpable, about one fingerbreadth below the costal margin, and the spleen was palpable on deep inspiration. The entire trunk of the skin was covered with a coppery red, papular eruption. The

papules varied in size, from about 1 to 3 cm. They were deeply imbedded in the subcutaneous tissue and were freely movable. There was also a small papular eruption on the flexor surfaces of the forearms and both tibiae. Both testes were enlarged, tender, and hard. The lymph nodes were almost all enlarged and were small and discrete. A small lymph node under the skin on the chest and abdomen was also felt. Blood pressure, 136/40; pulse, 116; temperature, 99° F.; respiration, 20.

Laboratory Findings.—Blood sugar, 103 m.; blood calcium 10.6 mg.; blood phosphorous, 5.25 mg.; blood urea nitrogen, 2.0 mg.; nonprotein nitrogen, 37 mg. per c.c.; phosphatase, 6.24 mg. (Bodansky); blood cholesterol, 150 mg.; total protein, 6.56 mg. Urine: occasional white blood cells, casts, and trace of albumin; reaction is acid; specific gravity, 1.020; Vincent's smear, negative. Acid fast organisms, negative; Wassermann, negative. Bleeding time, 3.5 minutes; clotting time 3 minutes. Blood count is shown on Hemogram (Table I).

TABLE I

HEMOGRAM

DATE	HEMOGLOBIN (%)	R.B.C.	W.B.C.	NEUTRO.	LYMPH.	LARGE MONO.	EOSIN.	BASO.
12/ 5/40	85	4,400,000	6,900	62	38			
12/ 6			6,100	65	34	1		
12/13	78	4,200,000	6,000	62	35	1	2	
12/19	86	4,450,000	5,900	53	29	2	15	1
12/20	93	4,700,000	5,900	49	40		11	
12/29	92	4,700,000	8,600	43	41	6	10	
1/ 3/41	75	3,950,000	6,200	56	37	3	4	
1/ 4	101	5,200,000	6,100	40	45	5	10	
1/ 7	90	4,800,000	6,000	42	48	1	9	
1/10	90	4,650,000	6,400	58	42			
1/12	95	5,000,000	6,100	43	40	5	11	1
1/15 (Date of discharge)	90	4,800,000	6,000	42	48	1	9	
12/19	Differential report: The monocytes are increased in number and in appearance of activity. This definitely suggests activity in the reticular system—reticulosis or monocytic leucemia.							

The striking features in this case were:

1. The boy was afebrile on admission.

2. The face was swollen and leonine in appearance and there was a suggestive saddling of the nose.

3. There was postnasal obstruction causing mouth gaping.

4. The gums were swollen, with marked expansion of the mandible and maxilla.

5. The skin eruption was discretely papulated over the extremities with nodules located intracutaneously and subcutaneously. The lesions were copper red except on the knees where they were purpuric; they were not painful or itchy.

6. Blood studies were essentially negative.

Dental Examination.—The lips appear normal in color but are dry with a slight brownish crust. The gingivae are extremely proliferated and hypertrophied. There is a marked puffiness in the canine areas with a slight oozing of dusky red blood. (Fig. 2.) The swelling covers more than one-third of the clinical crown of the anterior teeth. In the posterior region the gingivae are

tremendously swollen, so that only the occlusal surfaces of the teeth can be discerned. The hypertrophy is irregular and expansive and gives one the impression that the gingivae and buccal mucosa are infiltrated with a mass of spongy material from within. The teeth are spaced, and markedly loose, and the large expanded marginal gingiva surrounds the tooth completely, there being no contact point. The lingual side of the gingivae is also markedly engorged in an irregular fashion. The mucosa just underneath the gingivae on the lingual side presents no evidence of infiltration. Apparently the swelling on the lingual side is an extension of the extreme infiltration from the buccal and labial side. The interdental papillae extend to the marginal ridges and have no necrotic or hemorrhagic areas. The mucobuccal fold is irregular and not well defined, especially in the third molar areas. Palpation of the gingivae gives one a spongy crackling sensation. The sublingual space is negative. The hard and soft palate present a blue ecchymotic streak to the left of the center life. A marked fetor is present. The mouth hygiene is good and no calculus or stains are present on the teeth.

Fig. 2.—Note the marked nodular hypertrophy of the gums covering the teeth. Premolars and molars are covered with gum tissue so that only the occlusal surfaces are apparent. Teeth are extremely loose.

The patient complains of no pain or discomfort in the mouth. He only notices pain when he chews his food, and this is relieved when pressure is released. He claims that he must keep his mouth open because he cannot breathe through his nose. This can be attributed to the blockage of the nasal passages due to a similar infiltration into the nasal mucous membranes.

Roentgen Examination.—Because of the extreme looseness of the teeth, intraoral x-rays were ordered to observe the condition of the alveolar process. These reveal a marked generalized alveolar absorption of bone that extends for more than two-thirds of the root surface. There is an indication that this

process is rapid, because of the numerous bone septa suspended in soft tissue. The lamina dura is completely absent throughout, and the periodontal membrane space is thickened, diffuse, and irregular. The interdental space is exceptionally wide, both in the upper and lower jaws. There is considerable osteoporosis of both the mandible and maxilla. The pulp chambers are normal in size and complete calcification of the root ends is observed except in the second molars and upper canines. (Fig. 3.)

Fig. 3.—There is a generalized alveolar absorption of bone that extends over more than two-thirds of the root surface. There is extensive osteoporosis of both the mandible and maxilla. The lamina dura is completely absent and the periodontal membrane space is thickened, diffuse, and irregular. Areas of rarefaction seen in the canine and second molar root ends are probably due to incomplete calcification.

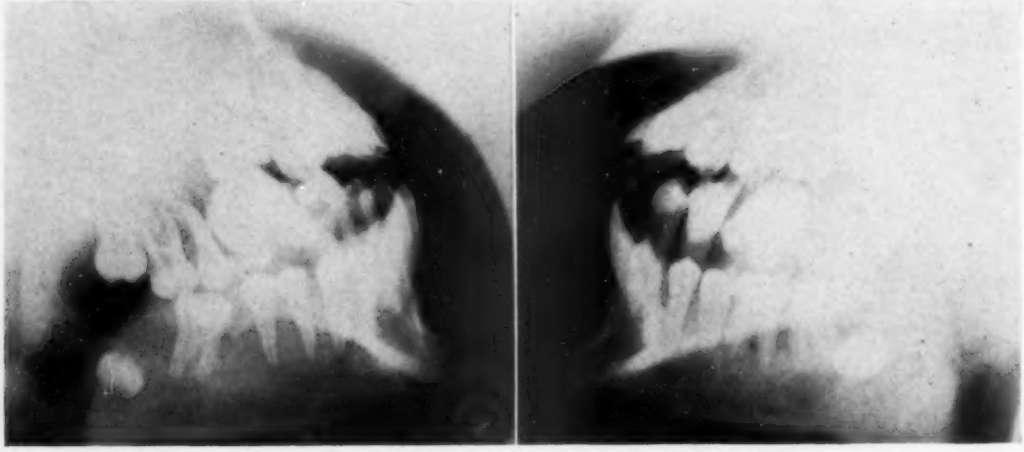

Fig. 4.—Observe the periosteal lifting in the mental region and the osteolytic character of the mandible.

The mandible appears to be increased in size, despite the alveolar absorption. There is a subperiosteal lifting in the mental region, and the second and third molar tooth buds are apparent, with marked areas of rarefaction. (Fig. 4.)

Because of these findings, further x-rays of other parts were suggested.

General X-Ray Studies.—X-ray studies reveal a generalized decalcification of the calvarium of the skull. There is some spiculization at right angles to the outer table observed in the frontal view. There is considerable osteoporosis of the maxilla and mandible associated with rarefaction, and there is considerable thickening of the mucous membrane in the nasopharynx with some encroach-

ment in the airways. The sella turcica is within normal limits. The skull itself is larger than normal for the age of the patient. There is marked polypoid hyperplasia of the ethmoids and thickening of the mucous membrane of the sphenoids.

The ribs present the same type of demineralization as do all the bones of the body examined, including the vertebrae, pelvis, each shoulder girdle, and arm.

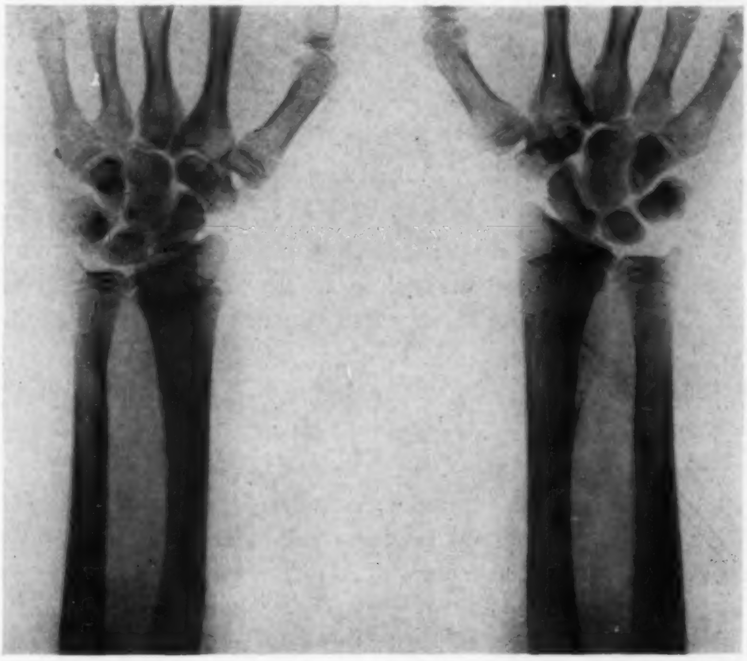

Fig. 5.—The periosteum is elevated away from the shaft and there is a sunray striation at right angles to the shaft which are spicules of new bone formation.

There are definite bone changes in the region of the ends of all the long bones, beginning particularly in the metaphyses and extending down about 2 inches. These changes are observed in the tibiae and fibulae near the ankle joints, and the radii and ulnae of both forearms. Similar changes though less marked are seen in the bones of the feet and hands. The periosteum is elevated away from the shaft and there is a sunray striation at right angles to the shaft, which are spicules of new bone formation (Fig. 5). There is observed also a crescentic indentation of the ends of the bones involving the cortex. There is absorption of some of the cancellous structure, so that the ends of the bone have a spongy appearance due to the resorption of the transverse trabeculae and prominence of the longitudinal trabeculae. The medullary cavity shows an oblique striation and areas of vacuolization. The epiphyseal lines seem to be somewhat disturbed and fade out, particularly in their center portions.

These profound osseous changes in structure and architecture occur in the lymphoid diseases, such as, a lymphosarcoma, leucemia, or a diffuse reticulosis.

Histopathologic Findings.—Glands were excised from the inguinal and axillary region for biopsy. The histologic report was aleucemic leucemia

(myeloblastic type). The report on the cutaneous nodules and sternal biopsy was the same.

Course of Disease.—The patient's mouth was examined daily during his stay in the hospital. In the last week he began to show signs of clinical improvement which were first noticed by the abatement of the oral lesions. The cutaneous lesions began to disappear, his face improved in appearance, and his swollen gums became markedly reduced. The teeth were more apparent both anteriorly and posteriorly. During his entire hospitalization period he received no therapy. By the time the patient was discharged he was able to breathe through his nose and could close his mouth. On the date of discharge there was only a mild gingival hypertrophy and the gums had lost their nodular appearance; but the teeth were still loose. The nodules on the head were still present, but were smaller in size. Four months later, the patient died at home. An autopsy was not obtained.

Discussion.—Alveolar absorption in both mandible and maxilla in leucemia are rare; the changes are secondary and are due primarily to pressure of the infiltrating lymphoid tissue. The roentgen changes in bone are usually of moth-eaten character, and osteolytic in nature, and are not diagnostically significant. Leucemias usually manifest bone lesions of an osteoporotic character but may also be osteosclerotic in type.[10] The lesions may manifest themselves in the long bones, skull, pelvis, scapula, vertebrae, mandible, and maxilla.

The bone changes in the foregoing case may have been attributed to the hyperplasia of the hematopoietic tissues with infiltration into the periodontal membrane. Burket[11] observed a case of acute monocytic leucemia showing histopathologic evidence of monocytes present in the pulp, periodontal membrane, and mandible.

The clinical and oral manifestations in the case reported were of the type usually found in monocytic leucemias, although the diagnosis on discharge was chronic aleucemic myelosis because of the variance between the histologic and hematologic reports. Forkner[6] suggested that marked hypertrophy of the gum tissue was a clinical pathognomonic sign to differentiate among lymphatic, myelogenous, and monocytic leucemias. Osgood,[5] in his analysis of 133 cases of monocytic leucemias, had found that marked hypertrophy of the gums was one of the most constant features, occurring in 80 per cent of 88 cases in which gums were mentioned. Splenic enlargement occurred in 84 per cent of 117 cases, lymph node enlargement in 77 per cent of 110 cases, and petechia occurred in 69 per cent of 80 cases in which they were searched for. The swollen gums were more marked and constant than in other types of leucemia and patients consulted their dentist before their physician. The early recognition of a generalized bone involvement by means of the intraoral films illustrates the value of routine intraoral x-ray examinations.

By observing the mouth lesions daily, we were able to note the early signs of clinical improvement which became manifest with the gradual disappearance of the oral and cutaneous lesions. Acute blood dyscrasias may sometimes change into a chronic phase, in which case the oral lesions may be the first to show signs of improvement.

SUMMARY

A case of leucemia with osseous dysplasia in the mandible and maxilla is described.

Bone changes are rare and are not diagnostically significant. These changes are usually osteolytic but may also be productive.

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IRRITATING POTENTIALITIES OF ROOT CANAL MEDICAMENTS

Louis I. Grossman, D.D.S., Dr. med. dent.

IN 1897, G. V. Black and A. H. Peck[1] conducted a series of experiments to determine the irritating properties of certain drugs then used in root canal medication. The medicaments tested were representative of those being used at the time, namely, oil of clove, oil of cinnamon, oil of cassia, Black's 1-2-3, beechwood creosote, and formocresol. The method of testing consisted of moistening a pellet of cotton with 3 drops of medicament, placing it against the forearm, and covering it with rubber dam. The latter was attached to the forearm by means of adhesive strips. Observations were made two days later for irritating effect on the skin.

Because of the simplicity of the method, and because reports on the irritating potentialities of root canal medicaments currently in use are extremely meager, the above method was employed to test germicidal agents used for the treatment of pulpless teeth in the Root Therapy Clinic of this school. In addition, formocresol, still used more or less by many dentists in practice, was included.

METHOD

Pledgets of cotton having a uniform size were placed in rubber polishing cups. Three drops of the test germicide were discharged from a small syringe on the surface of each cotton pellet. The syringe was made by fusing an iridioplatinum hypodermic needle of 25 gauge into the mouth of a silicate cement liquid dropper. The cups bearing the medicated pellets were then strapped on the upper arm of subjects by means of adhesive tape. The arm had been shaved of hair twenty-four hours previously. All germicides to be tested were applied on the arm of the subject at the same time, i.e., within about five to ten minutes. The "blindfold" method of testing was used, i.e., the order or sequence of medicaments differed in each subject and was unknown to the subjects. In fact, the subjects had only a general idea of the medicaments being tested. The subjects upon whom the tests were made were healthy, young dental students. The germicides tested were 1 per cent azochloramid in triacetin, beechwood creosote U.S.P., camphorated (65 per cent) monochlorphenol (35 per cent), cresatin, and formocresol.

After forty-eight hours the dressings were removed, the skin was swabbed with carbon tetrachloride to remove traces of adhesive, and the areas where the cotton pellets had been in contact with the skin were outlined with an indelible pencil. Photographs of these areas were then taken, in order to have an objective record of the reaction. Before removal of the dressings, some of the subjects pointed to areas which had itched, felt irritated or painful. These corresponded with the objective appearance of the reaction. (See Figs. 1 and 2.)

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RESULT

In all six cases, no objective signs of irritation or inflammation were present where azochloramid, camphorated monochlorphenol, or cresatin had been applied. Also, there were no subjective symptoms except for slight initial itching which soon wore off.

In all cases there was evidence of a mild or severe area of inflammation where beechwood creosote had been applied. No particular subjective symptoms were recalled.

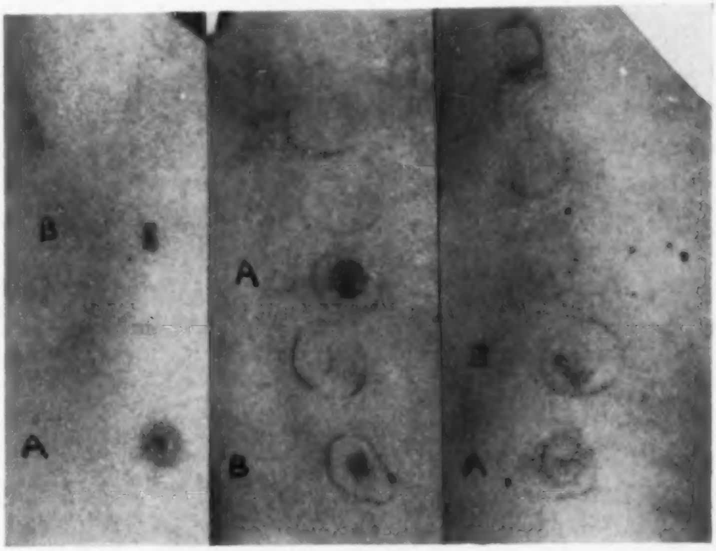

Fig. 1.—*A*, Formocresol; *B*, beechwood creosote. Arm 1 shows reaction to *A* and *B* but not to other medicaments used. Arms 2 and 3 show areas outlined with pencil where medicaments had been applied. *A* indicates reaction to formocresol, *B* indicates reaction to beechwood creosote.

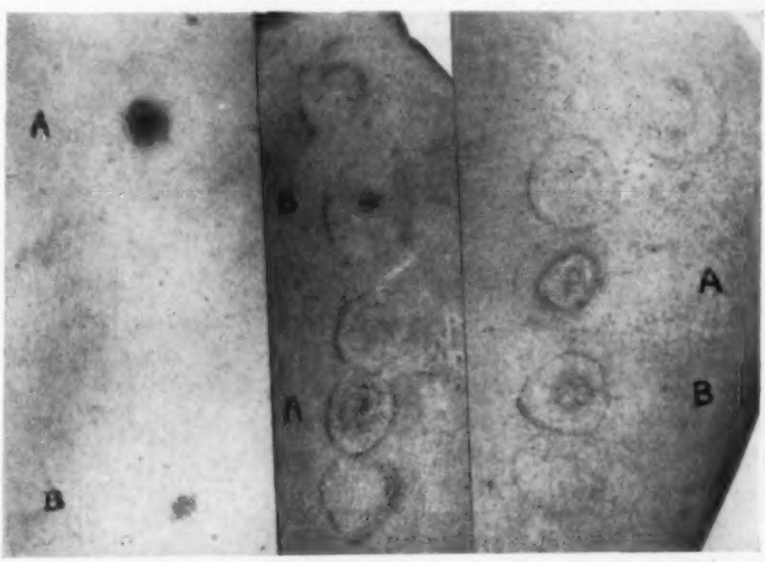

Fig. 2.—*A*, Formocresol; *B*, beechwood cresote. Arm 4 shows reaction to *A* and *B* but not to other medicaments use. Arms 5 and 6 show areas outlined with pencil where medicaments had been applied. *A* indicates reaction to formocresol, *B* indicates reaction to beechwood creosote.

In all cases there was evidence of a mild or severe necrosis where formocresol had been applied. These areas were painful, or, as one subject expressed it, "a numb pain" was felt.

Healing of the areas where beechwood creosote had been applied occurred in from two days to a week. Healing of the areas where formocresol had been applied occurred within two months in four of the subjects, within ten weeks in one subject, while a reddened area of inflammation which resists healing is still present in one subject at the time of writing this paper, namely, three months after application of formocresol.

DISCUSSION

It will be pointed out that skin reaction is not synonymous with periapical tissue reaction and that what happens upon the skin surface may not necessarily occur when the same medicament comes in contact with periapical tissue. This argument is conceded. On the other hand, it must be pointed out that periapical tissue is more sensitive than skin surface, and that if a medicament is irritating to the skin, it is even more likely to be irritating to the periapical tissue. The skin test is a simple and rapid method of determining the relative irritating effects of medicaments and may serve to rule out those medicaments which are likely to be too irritating for use in the treatment of pulpless teeth. Such tests may be amplified by animal experiment in which pulpless teeth are treated with the medicament in question and sections of teeth and periapical tissue are then removed and studied histologically. This method has been used by Coolidge[2] and by others.

Without entering into a discussion of the relative germicidal merits of the root canal medicaments examined, it would appear that azochloramid, camphorated monochlorphenol, and cresatin are safe drugs to use for the treatment of pulpless teeth. There is some question as to the desirability of including beechwood creosote in this category, although the degree of skin reaction observed was relatively slight and healing occurred within a short time. On the other hand, formocresol not only produced a severe necrosis of tissue, but repair in bridging this necrosis has been extremely slow. This would seem to confirm previous claims that formocresol interferes with repair of tissue.

SUMMARY

1. A group of five root canal medicaments were examined for possible irritating effects.

2. The medicaments were applied to the shaved skin of the upper arm for forty-eight hours. Observations were then made regarding immediate reaction, and time of healing where irritation or necrosis occurred.

3. Azochloramid, camphorated monochlorphenol, and cresatin produced no irritating effect. Beechwood creosote produced inflammation which lasted from two to seven days. Formocresol produced necrosis which lasted from two to three months.

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SKELETAL FIXATION OF PATHOLOGIC FRACTURES OF THE MANDIBLE WITH EXTENSIVE LOSS OF SUBSTANCE

Report of Two Cases

THOMAS M. MELOY, JR., D.D.S.,* AND JOHN H. GUNTER, D.D.S., M.D.†

NECROSIS, tumors, cysts, and trauma may cause extensive destruction of osseous tissue. When these pathologic conditions exist within the mandible, causing an extensive loss of substance, a spontaneous fracture can occur. Treatment of a fracture of this sort must, of necessity, make allowance for (1) maintenance of proper contour, (2) accessibility for surgical treatment, (3) nutritional requirements of the patient, and (4) in some cases, the early insertion of dentures.[1]

CASE 1

History.—W. W. was admitted to the Episcopal Hospital, March 2, 1943, suffering from extensive first, second, and third degree burns of the chest, arms, hands, face, and back. His family history and past medical history were irrelevant. He received active treatment for two months, during which his general condition improved with varying degrees of healing of the burned areas. On May 12, 1943, the patient complained of pain in the left jaw. Oral examination revealed that the left mandibular first molar had a large cavity apparently involving the pulp chamber. The tooth was loose, with pus escaping at the gingival margin. Its removal was recommended. On July 12, 1943, Dr. I. M. Boykin, surgeon in charge, considered the patient's condition satisfactory for removal of the tooth. The tooth was extremely loose and no difficulty was experienced. Anesthesia was not necessary. On July 17, the patient's jaw collapsed, and roentgenologic examination disclosed a displaced fracture of the left side of the mandible, accompanied by a decrease in the density of the bone suggestive of osteomyelitis. Subsequent examinations confirmed this diagnosis. The patient's general condition precluded any consideration of intraoral fixation. The patient had difficulty in obtaining adequate nourishment and was loosing ground. Permission was obtained from Dr. Boykin to use skeletal fixation. Preoperative roentgenologic examination now disclosed an extension of the necrosis to include an area of about 4 cm. (first premolar to second molar). The right side of the mandible was displaced toward the median line with loss of occlusal contact. (Fig. 1.)

Operation.—(Sept. 8, 1943.) Using heavy sedation and infiltration anesthesia, two Biglow screws were inserted into healthy bone along the posterior

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Fig. 1.—Osteonecrosis with collapse of the jaw.

Fig. 2.—Intermaxillary relationship restored with Biglow appliance in place.

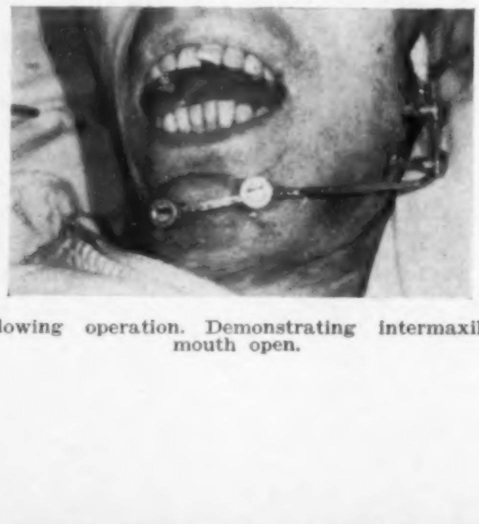

Fig. 3.—Two days following operation. Demonstrating intermaxillary relationship with mouth open.

border of the left ramus and two screws into healthy bone anterior to the canine on the same side.[2] The Biglow arch bar was adjusted to connect these screws and restore the normal intermaxillary relationship. Several sequestra and the left mandibular second molar were then removed. No supplemental intermaxillary wiring was used. (Fig. 2.)

Postoperative Course.—Recovery was uneventful. On the second day the patient was able to enjoy semisolid foods. (Fig. 3.) His spirits and general condition were greatly improved. This state of affairs continued until Oct. 7, 1943, when his kidneys suddenly began to fail and uremia developed. In spite of heroic medical treatment the patient died on October 9. At time of death the Biglow appliance was still firm and tissue regeneration was progressing between the fragments.

Comment.—Had the patient survived his medical complications, we felt there was a good possibility of complete bony regeneration; otherwise, bone graft would have been considered.

CASE 2

History.—Mrs. C. K., aged 57 years, had visited her dentist complaining of pain in the right mandibular molar area. The first and second molars were extracted at this time. Pain subsided and the patient exhibited no further symptoms for several weeks, when she noticed a circumscribed swelling on the buccal surface of the right side of the jaw. The swelling continued to increase, and symptoms developed which caused the dentist to suspect osteomyelitis. He then referred her to the Episcopal Hospital. Intraoral examination revealed the absence of all teeth on the right side of the jaw posterior to the first premolar. This enlargement of the mandible extended from the second premolar to the anterior border of the ramus. There was some drainage in the molar region. Roentgenologic examination disclosed a large radiolucent area in the right mandible extending from the second premolar area posteriorly to the ramus. All the bone had been destroyed with the exception of the alveolar crest. There was a pathologic fracture in the second molar region. (Fig. 4.)

Preoperative Diagnosis.—Osteolytic tumor of the mandible accompanied by a pathologic fracture.

Operation.—A skeletal fixation appliance designed by one of us (T. M. M.) was applied as follows: Through stab incisions, vitallium screws were inserted in the usual manner into healthy bone beyond the limits of the tumor. A piece of clear acrylic, shaped to simulate the contour of the mandible, was held over the ends of the screws, and marks were made at the places the screws contacted the acrylic splint. Holes were then drilled through the splint at these points and the splint slipped on the screws. The nuts were tightened, locking the appliance into position. (Fig. 5.) An incision was made beneath the mandible, and the osteolytic mass was enucleated. No supplemental intermaxillary wiring was used.

Postoperative Course.—The patient's recovery was uneventful. Histologic examination of tissue removed proved it to be a myeloma (plasma cell type). The patient is receiving radiation therapy, is free of pain and able to eat soft foods. She has no difficulty in performing the normal mandibular movements.

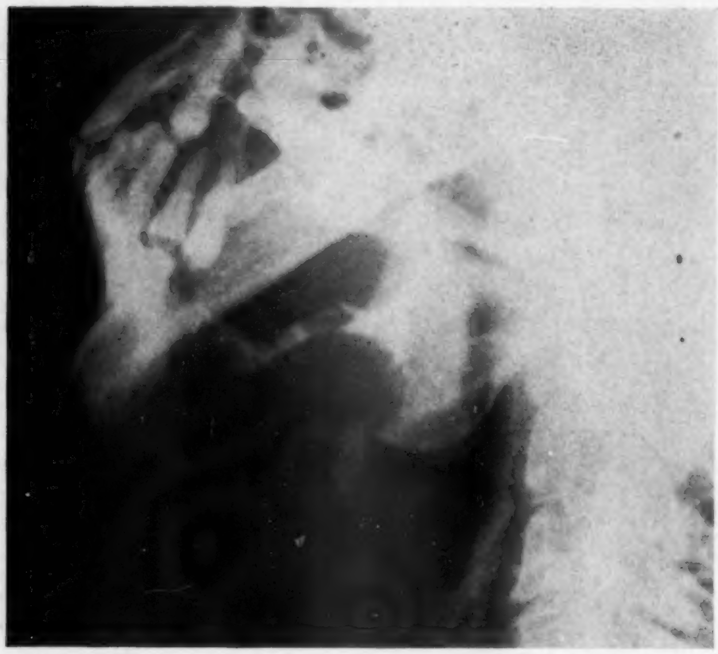

Fig. 4.—Preoperative x-ray showing extent of osteolytic process with pathologic fracture.

Fig. 5.—Acrylic extraoral splint locked in position.

Fig. 6.—Two weeks following operation. Patient can open mouth without undue difficulty.

(Fig. 6.) At the time of this report the appliance has been in place for twelve weeks. It is still firm and has required no adjustment. The skin is healthy about the screws. A recent roentgenogram shows a slight change in the margins of the area suggestive of osteogenesis. (Fig. 7.) The alveolar crest seems firm on palpation. The appliance will remain in place until there is conclusive radiographic evidence of regeneration of sufficient bone to maintain the fragments in their present position.

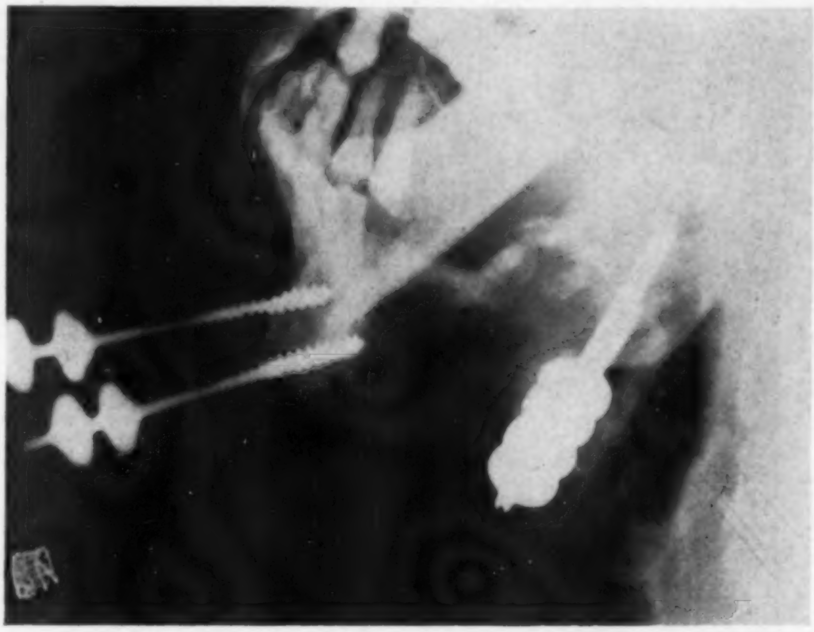

Fig. 7.—Twelve weeks following operation. Evidence of osteogenesis.

Conclusions.—Treatment of fractures of the mandible accompanied by a loss of substance requires ingenuity on the part of the operator. Skeletal fixation appliances are less complicated in their application than other methods that have been designed to immobilize fractures of this type. We have found that screws having heavy threads (wood screw type) remain firm in the bone over a longer period of time than those with fine threads. The acrylic extraoral splint, as described, presents a simple means of applying skeletal fixation to fractures of the mandible, particularly where there has been loss of substance.

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A "FIXED REMOVABLE" BRIDGE WITH BIOLOGIC ANCHORAGE

Report of a Case

Alton J. Novak, B.S. in Phar., D.D.S.*

A NEGRO woman, aged 43 years, came to the Department of Oral Diagnosis in December, 1943. She complained of a dull persistent pain in the anterior maxillary region. This pain was present only when pressure was applied to this area.

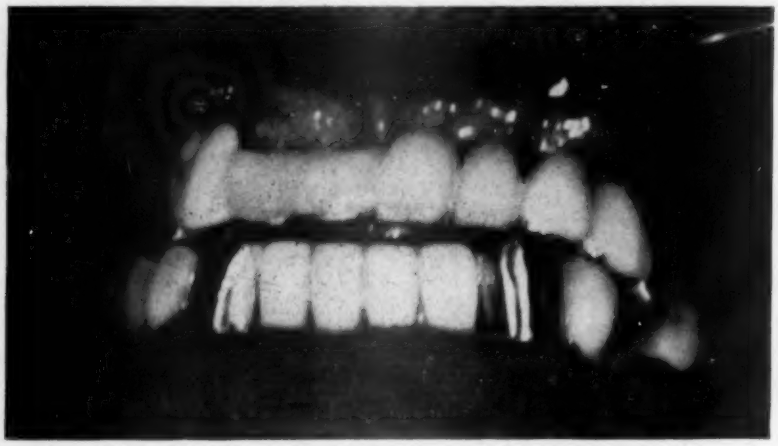

Fig. 1.—Bridge in position, with paraffin wax replacing lost facings.

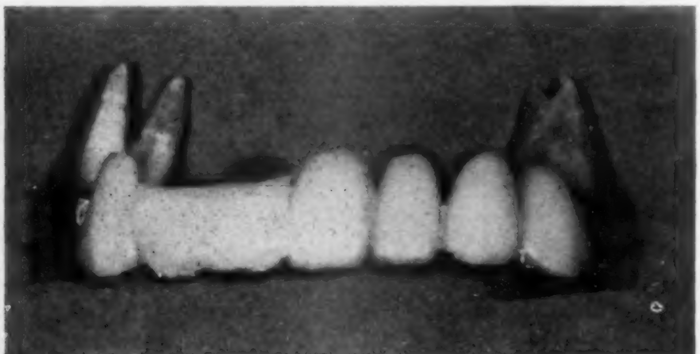

Fig. 2.—Bridge removed from the mouth, showing the attached abutments.

A maxillary bridge had been constructed five years before as a temporary measure because the patient "could not afford to spend any more for a full denture at that time." At this time the patient was cautioned by her dentist concerning the inadvisability of a fixed bridge with so large a span. (Fig. 1.)

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This bridge became loose gradually and the abutment teeth were slightly painful on pressure during eating. The patient fell full face against a banister in August, 1943, but thought nothing of it until the bridge fell out at dinnertime. (Fig. 2.)

Examination of the mouth revealed a loose fixed bridge which extended from the maxillary left first premolar to the right second premolar. Several missing pontics were filled in with white wax. Four other teeth, the left first molar, the right second premolar, and the right first and second molars were present in the maxilla. A fixed bridge which extended from canine to canine, and the first left and right premolars were present in the mandible. No abnormalities were observed on the buccal mucosa, the gingivae, or the tongue.

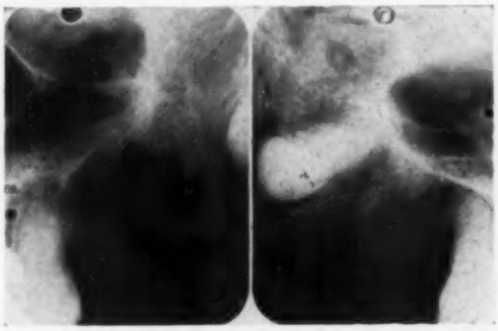

Fig. 3.—X-rays showing sockets of the abutment teeth.

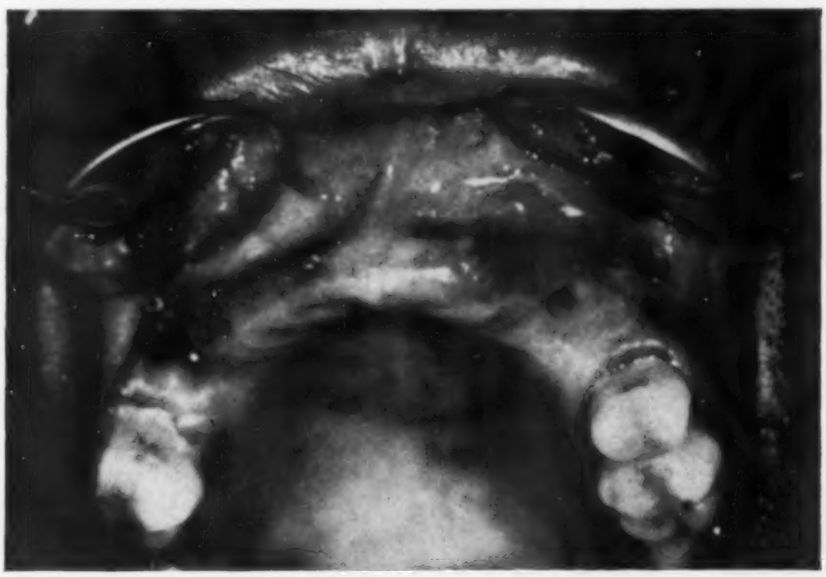

Fig. 4.—Epithelialized sockets of abutment teeth.

Periapical films of both abutment teeth revealed a radiolucent area compatible with the failure of bone to fill in following a recent extraction. An impacted left maxillary canine was an incidental finding. (Fig. 3.)

The large, anterior maxillary bridge consisted of two gold shell crowns still attached to the abutment teeth, whose exposed roots were grossly devoid of

epithelial or connective tissue. The root ends were cleansed and inserted by the patient into their respective sockets whenever the occasion arose. When the bridge was kept out of the mouth for any length of time, the patient experienced a little difficulty in inserting it in its usual position. The sockets appeared to be completely epithelialized and there was no visible bleeding. (Fig. 4.)

Complete healing took place four weeks after the impacted tooth was removed and the bridge was no longer inserted into its "sockets."

The novelty of seeing a "fixed removable bridge" with its biologic anchorage by means of the clean root tips of the abutment teeth is believed to justify this report. This bridge was held reasonably firm in position when these root tips were inserted in their sockets but was of little functional value.

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THE CLINIC OF THE MASSACHUSETTS GENERAL HOSPITAL AND THE HARVARD SCHOOL OF DENTAL MEDICINE

Volume III

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INTRODUCTION

THE third Massachusetts General Hospital Number contains some of the cases treated during the first half of 1944. An unusually large number of patients with interesting cysts were seen, and the usual number of fractures were treated; of these many involved the condyle of the jaw and were associated with various complications such as displacement of the condylar fragment and fracture dislocation. Five of these cases were treated by open reduction and internal wiring fixation with a method developed by us, which will be presented in a special paper to be published later. Several patients who presented severe trifacial neuralgias were relieved by decompression of the mandibular nerve or by neurectomy. Neck infections of odontogenic origin received routine treatment, incision and drainage, and extraction of involved tooth or teeth with chemotherapy. A case is presented in which a deciduous tooth was the cause of a submaxillary abscess, because deciduous teeth are frequently overlooked in such cases. A patient with osteomyelitis from an unusual cause is added to show that bone infections require surgical removal of sequestra, even though they are treated with penicillin for infections caused by penicillin-sensitive bacteria.

Fibrin foam and thrombin, which was put at our disposal by the Department of Physical Chemistry of the Harvard Medical School for experimental use, was employed in several operations to arrest hemorrhage. It may be placed into any deep cavity to arrest capillary oozing or venous bleeding, but it is particularly effective in stopping hemorrhage in bone operations. It has been successfully used after condylectomies, and in bleeding bone cavities such as result after removal of cysts or after operations for decompression of the mandibular nerve. The foam is soaked in the thrombin, and packed into the cavity with gauze. Being a product made from human blood, it can be left in the wound without producing any body reaction. It arrests hemorrhage almost instantaneously and permanently.

Penicillin has been used in two of the reported cases for the treatment of osteomyelitis of the jaw, and we are indebted to Dr. Chester Keefer and Dr. Donald Anderson for the supply of the drug for experimentation.

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I. LARGE CYSTS OF THE MANDIBLE

That we know very little of the pathogenesis of odontogenic cysts is realized when we ask the questions: How rapidly do they form? and what governs the rate of growth? In this clinic we have seen a number of unusually large cysts during the last six months. Out of the six included in this report, five occurred in patients under the age of 25 years. One of the cysts was a radicular cyst, a type which may develop at any age from a granuloma formed at the apex of a carious tooth. The remaining cases were follicular cysts; two of them contained teeth which entitles them to the subclassification of dentigerous cyst. Follicular cysts presumably start to form during the developmental stage of the particular tooth germ from which they are derived; it is clear that their onset coincides with odontogenic activity. When follicular cysts are found to have developed to a size larger than those found in older individuals, we can deduce that the rate of growth of cysts varies greatly. Most cysts that we find in adults do not cause much facial deformity, while all the large cysts in young patients reported here had expanded the jaw considerably. Why did they grow so large so quickly? The picture is further confused by the fact that we have seen two or three cysts in the same patient, with one larger than the others.

We know that certain substances, which we may roughly classify as carcinogenic substances, stimulate growth of neoplasms. Do cysts contain such stimulating substances? What do we know about the material contained in follicular cysts? Cysts generally contain a clear yellowish fluid which, in some instances, contains shiny cholesterol crystals. In some, these crystals are so numerous that they form a soft cheesy mass, often termed cholesteatoma. We are interested in whether the rate of growth of a cyst depends on transudation of fluid through the epithelial lining of the cyst sac, on the secretion of the epithelial cells, on the deposit of cholesterol, or on the stimulation by other chemical substances found in the contents of the cyst. Here is an opportunity for investigation and experimentation.

The differentiation of follicular cysts from adamantoblastoma is not always easy. We note that of the six cysts reported four are monolocular, and two are multilocular. The number of compartments therefore is not significant. Adamantoblastoma likewise may appear in mono- and multilocular types. We have found certain roentgen signs which we believe indicate tumor formation, or which at least should warn us to make a guarded diagnosis. The most significant of these are small niches interrupting the border of the bone defect, and small daughter cysts around the main compartment. These frequently denote invasion of the surrounding bone, which is more commonly found in tumors than in an ordinary cyst. A break-through in the cortex of the bone may be found both in cysts and in adamantoblastoma. It was seen in two of the six cases (Cases 51 and 52). In dentigerous lesions the location of the tooth may serve as a diagnostic aid. The tooth is pushed away in the direction of the root apices by the cystic pressure, while in the adamantoblastoma, teeth, if present, may be completely enclosed in any part of the lesion. In addition, neighboring teeth, if encroached upon, are generally displaced or pushed away by cysts (Figs. 230 and 237), but become included in tumors. That these rules

cannot entirely be depended upon is shown in this series; for example, daughter cysts are shown along the alveolar process in Fig. 233, which, on pathologic examination, were found to contain connective tissue only. In Case 52 the extension of the lesion to the first molar (Fig. 242) is characteristic of adamantoblastoma, but there was no evidence of it pathologically.

Case 47

Radicular Cyst of Mandible

G. B. (No. 437112), a 12-year-old Canadian boy, was referred to this hospital and seen for the first time in the Dental Clinic of the Outpatient Department on Feb. 8, 1944. He presented a tumor mass on the left mandible, which was his chief complaint.

Fig. 228.—Twelve-year-old boy with swelling of the face caused by radicular cyst.

The swelling was first noticed a year before, in October. At that time the lump was small and caused no pain or discomfort. It was located in the mucobuccal fold. The mass grew steadily larger until it was the size of a lemon. The only symptom was some pain in cold weather.

Physical examination showed a large, hard swelling with no signs of inflammation. The first and second molars were broken down, and the mucobuccal fold was obliterated. Otherwise the physical examination was essentially negative.

X-rays were taken on February 8. The following is the report of the roentgenologist: "There is an expanding cystlike lesion involving the horizontal ramus of the left mandible (Fig. 229). It extends from the cuspid area to the

third molar region. A definite break in the cortex of the bone is not seen although it is markedly thin and expanded. The first molar roots are tilted, the second molar is carious, and the second premolar shows resorption of its root apex (Fig. 230). Although adamantinoma cannot be ruled out, there is a definite possibility that this represents a radicular cyst."

At the Tumor Conference, where this patient was presented, it was the general opinion that this cystic area was an odontogenic cyst rather than adamantoblastoma. Excision was advised.

He was admitted to the House on February 10, for operation on Februuary 11. With the usual preoperative medication, and intratracheal nitrous oxide, oxygen, and ether anesthesia, an incision was made at the gingival margin from the third molar region to the canine region with extensions at each end down over the outer wall of the mandible. The mucoperiosteum was detached, and a greatly expanded mandible was seen, the wall of which was extremely thin. An opening was cut through this bone, and, by means of suction, about 1½ ounces of yellowish fluid was removed. Two premolars and two molars were extracted, after which a large perforation into the cyst was made by cutting away about half the outer surface of the mandible. The cyst sac was then detached from the bone and dissected away from the mandibular nerve which was preserved. The cyst membrane was removed in toto. The bony wall of the cyst was then inspected to see that no membrane had been left. The mandibular nerve was found to traverse the cavity in a posteroanterior direction (Fig. 231). The outer wall of the cyst was then further reduced, and the lower third, which was extremely thin, was collapsed into the cyst cavity to decrease the facial deformity. Three grams of sulfanilamide powder were dusted into the wound, and a gauze pack made of boric strips was inserted to fill it completely.

The pathologic specimen consisted of a partially torn cyst (Fig. 232) measuring 3 by 4.5 by 3.5 cm. The wall was thin, averaging 1 mm. in thickness, and the lining was smooth. At one pole a molar tooth was attached, showing considerable decay of the crown. To the other pole was attached a fragment of bone measuring 1.5 cm. No epithelial lining was seen. The wall contained many chronic inflammatory cells. The pathologic diagnosis was radicular cyst.

On the first postoperative day, the patient was comfortable, but there was a slight amount of bleeding. Sterile gauze packs were inserted intraorally to control it. No swelling was present.

He was given 2.5 Gm. sulfadiazine postoperatively on February 13, and 3 Gm. every day until February 18, when the sulfadiazine level in the blood was 3.5 mg. per cent.

His condition remained good. The gauze pack, which was adherent to the floor of the cystic cavity, was removed on February 17 under local anesthesia. A slight swelling was noticed at this time. He was given warm mouth rinses. The dressing was changed and the area irrigated with weak hydrogen peroxide every day. The entire bone wall of the cavity was well covered by a new tissue. The patient was discharged with strict instructions for home care, to be followed in the Outpatient Department.

Fig. 229.—X-ray of mandibular cyst, anteroposterior view.

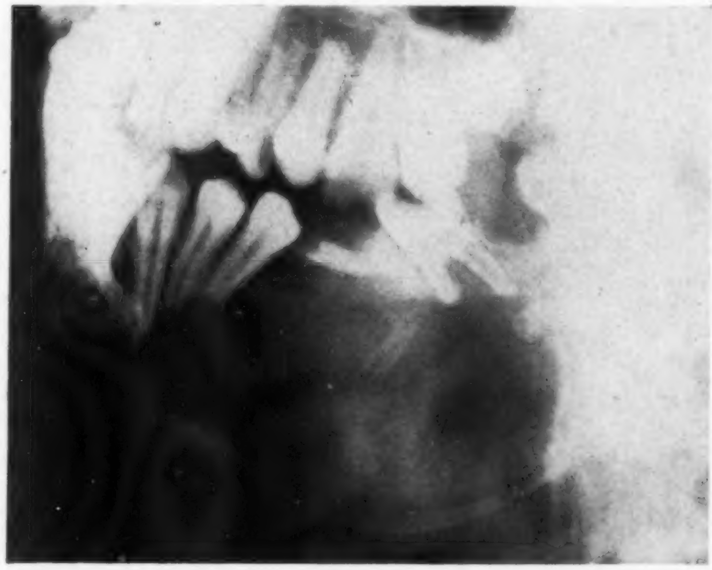


Fig. 230.—X-ray of cyst, lateral view.

Fig. 231.—Bone cavity after removal of cyst membrane. Note the mandibular nerve stretched across the cavity.

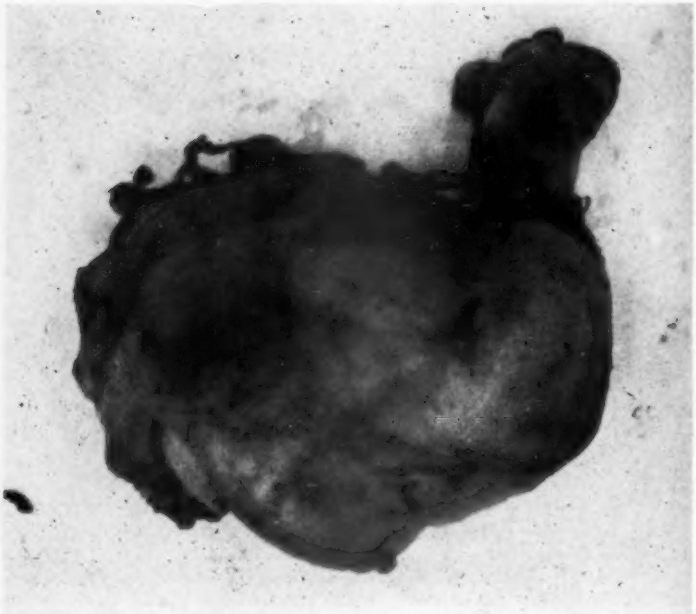


Fig. 232.—Cyst sac attached to apices of molar tooth.

He was seen in the Outpatient Department on February 21. His face was still slightly swollen. The cavity was being slowly filled in by normal granulation tissue. It was irrigated and painted with zephiram. A new borated gauze strip was inserted.

On February 23 his face was considerably swollen and there was slight trismus present on the left side of the jaw. In the distal part of the cavity there was a yellow-colored tissue which appeared necrotic. This was cleared out and the cavity was irrigated with warm saline, painted with zephiran, and packed lightly with borated strips. Two days later, the swelling and trismus had practically disappeared.

On April 5, the wound was healing well and was completely epithelized. There was no pain or numbness of the lip. The patient was discharged to the care of his local dentist.

Case 48

Dentigerous Cyst of Mandible

F. S. (No. 442756), a 25-year-old woman, was admitted to the hospital on March 28, 1944, complaining of a cystic swelling on the right mandible.

In September, 1943, she first noticed a slight swelling of the face. She went to a local dentist who told her the swelling was due to the erupting third molar. In February, 1944, she went to another dentist who took two x-rays of the right mandibular third molar and referred her to a roentgenologist who took x-rays of the jaw. The patient was informed that she had a tumor.

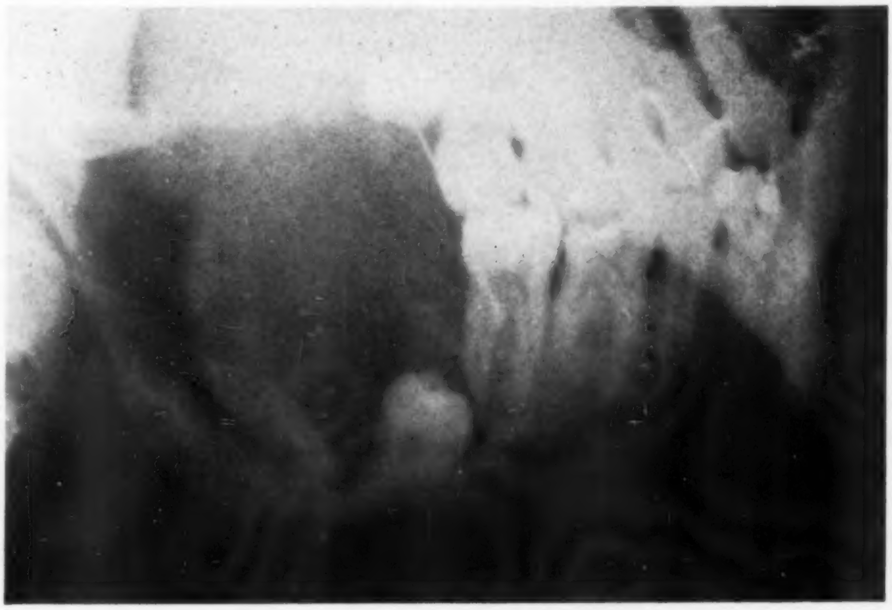


Fig. 233.—X-ray of dentigerous cyst expanding ramus.

Physical examination revealed a lemon-sized swelling of the right mandible and ramus. Intraoral examination revealed that the anterior border of the ascending ramus practically touched the maxillary second molar, which caused difficulty in occluding her teeth. The growth was otherwise asymptomatic.

X-ray examination showed a large dentigerous cyst occupying the entire ramus including the coronoid process. The ramus appeared expanded and there were several osteolytic areas along the alveolar ridge posterior to the second molar tooth. The third molar was embedded at the inferior border of the mandible, and the distal root of the second molar seemed to be involved (Fig. 233).

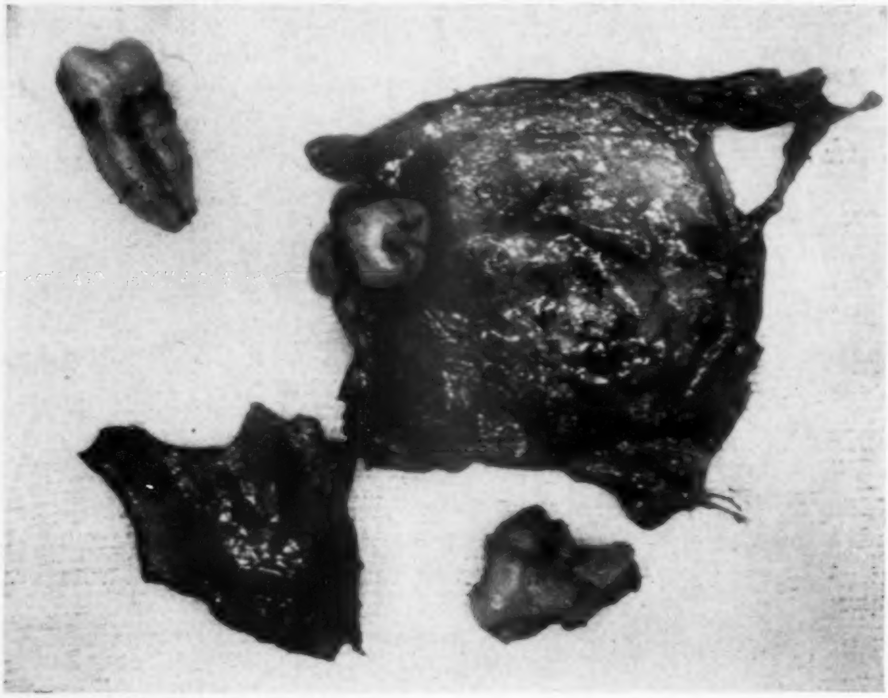


Fig. 234.—Cyst sac attached around the neck of the third molar, the crown of which protruded into the cyst cavity.

The usual preoperative medication was administered on March 29, when, under nitrous oxide, oxygen, and ether anesthesia given with an endotracheal tube, an incision was made on the anterior border of the ramus to the second molar. The bone around this tooth was cut away with a chisel to facilitate its extraction. The mucoperiosteum was then dissected away from the bulging cyst wall. On the inner side considerable bone was found, while on the outer side the ramus was of parchmentlike character. After removing a considerable part of this thin bone, the cyst sac was detached by blunt dissection and removed in two pieces, one containing the unerupted third molar. At the lingual side considerable thickening was noticed in the alveolus, and this was cut away for microscopic examination. The mandibular nerve was left intact in the bottom of the cyst cavity. Sulfanilamide powder, 1 Gm., was dusted into the bone wound, after which the cavity was loosely packed with a boric strip.

Submitted for pathologic examination was a previously opened, reddish-pink cyst measuring about 4 by 2 cm. to which was attached a molar tooth. The wall of the cyst was fairly smooth with areas of roughening and hemorrhage. Also submitted were two fragments of reddish tissue measuring 4.5 cm., and another molar tooth (Fig. 234). Some areas of the tissue were practically

cartilaginous in consistency. The pathologic diagnosis was dentigerous cyst. Fig. 235 shows a section of the cyst wall with the thinned-out bone lined by the epithelized sac. Sections made of the alveolus containing the osteolytic areas showed them to contain fibrous connective tissue; there was no evidence of adamantoblastoma present.

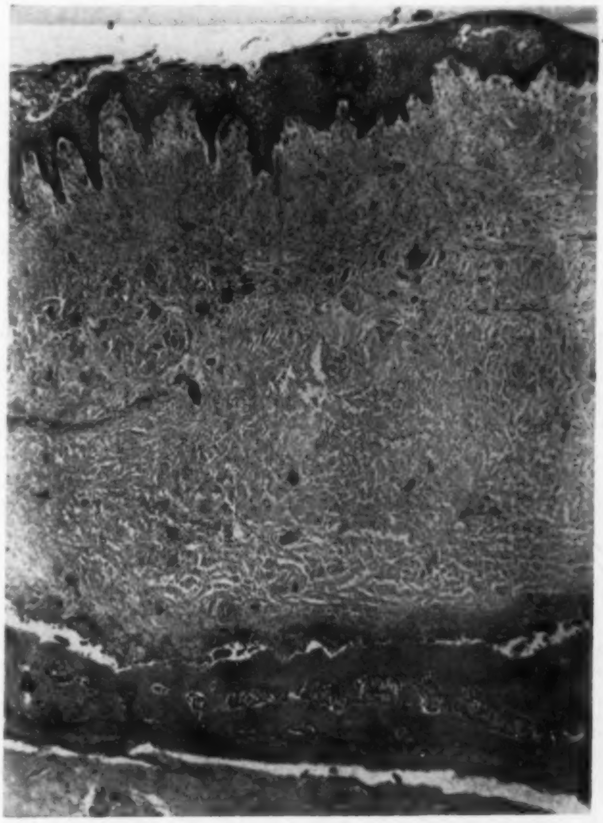


Fig. 235.—Cyst membrane with a thinned anterior bony wall of the mandible.

Postoperatively the patient was comfortable with only slight oozing from the operative field. A slight swelling was present. By April 3, the bone cavity seemed to be well covered with granulation tissue. She was discharged from the hospital on the seventh postoperative day to be followed in the Outpatient Department, from which she was discharged on April 20 to the care of her local dentist.

Case 49

Follicular Cyst of Mandible

R. L. (No. 432994), a 21-year-old ex-Air Corps Cadet was referred to the Outpatient Department Dental Clinic on Jan. 6, 1944, with a probable diagnosis of a cyst in the lower left mandible.

He first became aware of pain and swelling while flying in the U. S. Army Air Corps. On Oct. 7, 1943, when the altitude of his plane was approximately 11,000 feet, and the speed was 150 miles per hour, he noticed pain in the lower

molar region, the mandibular joint, and the lateral side of his neck on the left. However, he claimed that he had been in a pressure chamber simulating an altitude of 38,000 feet, without noticing any discomfort.

The company dentist at Bainbridge, George, incised and drained the swelling, and within two days it subsided. X-rays, however, showed a cyst extending from the lower left molar to the mandibular joint. He was refused treatment at the base hospital because they claimed that he had this condition previous to entry into the Armed Forces. He was, therefore, given a medical discharge.

The physical examination was essentially negative except that he had a small movable mass at the angle of the left jaw about the size of a marble, which was indurated and tender on pressure. There was a second nonmovable diffuse enlargement along the ramus of the mandible, extending halfway up to the joint. The lymph nodes were not enlarged or tender. The general physical condition was good.

Fig. 236.—X-ray of follicular cyst.

X-ray examination on Jan. 6, 1944, showed a 6 by 2.5 by 2 cm. cystlike lesion in the left side of the mandible starting at the level of the distal root of the molar and extending upward into the ascending ramus and to the base of the coronoid process (Fig. 236). The jaw appeared to be expanded medially, without any definite break in the cortex. The third molar was absent. Diagnosis: follicular cyst.

He was admitted to the House on January 10. The usual preoperative medication was prescribed, and on January 11, under nitrous oxide, oxygen, and ether anesthesia given by the intratracheal method, an incision was made along the anterior border of the ramus. After the mucosa was spread and the

bone exposed, a perforation was noticed from which cystic fluid escaped. This perforation was enlarged by means of rongeur and back-biting forceps and extended along the entire anterior border of the ramus. A cystic membrane was detached from the bone and dissected out. After it was removed, the mandibular nerve and artery were visible in the bottom of the bone defect. The edge of the bone was made smooth, and 4 Gm. of sulfanilamide powder were inserted as well as a boric strip. At the upper part of the ramus the incision was closed with sutures, the gauze pack being allowed to extend up through the rest of the wound.

Pathologic examination of several strips and sheets of smooth red membranous tissue was made. The pathologic diagnosis was cyst with acute and chronic inflammation and necrosis.

A culture made from the mandibular cyst showed a moderate growth of alpha hemolytic streptococcus.

On January 12, 13, and 14, the patient had some swelling in the submaxillary region. Chemotherapy was instituted on January 14. He was given sulfadiazine, 2 Gm. to start and 1 Gm. every four hours.

By January 17, the swelling had subsided considerably. The packing was removed, the wound irrigated with saline, and a new gauze strip inserted. The patient was discharged to be followed in the Outpatient Department.

When he was seen on January 21, the cyst was healing well. It was irrigated and painted with zephiran, and new borated gauze was inserted. On March 15, the wound was healing very well, and the patient stated that he had gained 15 pounds since the removal of the cyst. He was discharged on March 17, completely relieved.

Case 50

Dentigerous Cyst of Mandible

J. S. (No. 445792), a 20-year-old man, came to the Outpatient Department Dental Clinic on April 24, 1944, complaining of a swelling in the right mandible.

Two years before, he was hit on the right side of his mandible by a baseball. His face was slightly swollen and painful for about one-half hour thereafter, but these symptoms subsided without treatment. About one year ago, his brother noticed that the patient's jaw looked asymmetrical. A hard, nontender, painless lump about the size of a grape was found to be protruding into his mouth, and outward on his face. He stated that the swelling had increased in size slowly during the past year. The lump had never been painful or tender, and he experienced no difficulty in chewing or swallowing, but one month before coming to the Dental Clinic, he "tasted pus" after eating. The following day, about three tablespoons of thick, dark, foul-tasting pus drained from the lesion, which kept discharging intermittently for the next two weeks, and then drained continuously, especially on the opening and moving of his jaw. He consulted a physician, who x-rayed his jaw and said there was a "cystlike tumor" present.

Physical examination showed a swelling from the cuspid to the second molar region of the right mandible which was about 4 by 6 cm. in size, hard, im-

movable, and slightly tender. Pus was seen to be draining out beside the teeth over this mass. Three molars were displaced medially. There were several enlarged lymph nodes in the submandibular area. The physical examination also revealed a soft blowing systolic murmur of the heart which was heard equally well at apex and base. The rest of the examination was essentially negative.

The patient was admitted to the House on April 27, and x-rays were taken the next day which showed a large cyst in the right mandible extending from the region of the right lower central incisor to the second molar area. It apparently involved the roots of the teeth and there was an unerupted tooth protruding into the cyst. The mandible appeared to be somewhat expanded without definite destruction of the margins of the bone. The x-ray findings were felt to be consistent with a diagnosis of dentigerous cyst (Fig. 237).

Fig. 237.—X-ray of dentigerous cyst formed around canine tooth.

On April 28, after the usual preoperative medication, and under endotracheal nitrous oxide, oxygen, and ether anesthesia, the dentigerous cyst was excised. An incision was made along the gingival margin on the right side of the mandible extending from the incisor to the second molar region. At each end the incision was extended on the outer surface of the jaw, and the mucoperiosteum was detached from the bone. A thin cystic wall was exposed and opened. At this time purulent fluid escaped, and more of it was aspirated. The two premolars and the first and second molar roots were seen extending into the cystic cavity and were removed. On inspection of the cyst the crown of an unerupted displaced canine was seen, and when the cyst sac was detached from the bone, it was found attached to the cervical portion of this tooth. The cyst seemed to be made up of three compartments, and the membranes were removed in three pieces. The canine tooth also was removed. The cyst cavity finally was examined, at which time the mandibular artery and nerve could be

seen intact, but all the cystic tissue had been removed. A dressing made up of several boric strips was inserted into the cavity. The patient was returned to the ward in good condition.

The pathologic diagnosis was dentigerous cyst with chronic inflammation (Fig. 238).

Sulfadiazine therapy was instituted on the first postoperative day. The patient received 2 Gm. to start and then 1 Gm. every four hours. On May 1, the sulfadiazine level in the blood was 13.4 mg. per cent. Sulfadiazine therapy was discontinued on April 30. On the first postoperative day there was moderate pain in the jaw, partly relieved by an ice bag. There was a moderate discharge for several days, but the temperature chart was flat. He was discharged, to be followed in the Outpatent Department Dental Clinic, on the third postoperative day.

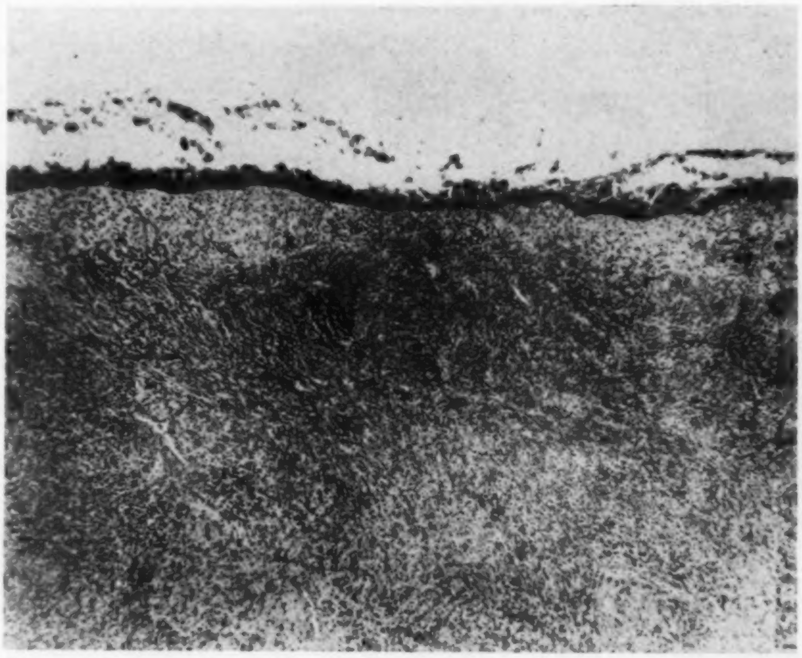


Fig. 238.—Cyst membrane with epithelial lining and inflammatory infiltration.

On May 3, the cavity was irrigated with warm saline, swabbed with zephiran, and repacked with gauze. One week later his mouth was syringed with Dobell's solution, and, because of pain, packed with iodoform and obtundia gauze. The dressing was changed on May 15, when the area showed good granulation tissue. On May 18, the dressing was again changed, and the wound was irrigated with Dobell's solution. The granulation tissue continued to increase. The dressing was removed on May 22, and the patient was instructed to irrigate the wound with warm saline solution after each meal and at bedtime. One week later, granulation tissue was seen to line the cavity completely. One month later, healing was progressing satisfactorily and he was advised to continue the home irrigations.

Case 51

Multilocular Cyst

M. H. (No. 435934), a 61-year-old woman, was admitted to the hospital on Jan. 28, 1944, with a chief complaint of swelling of the right lower jaw.

Two weeks before, at the time of a tooth extraction, she was told by her dentist that she had a swelling in the right lower jaw. She had noticed some external swelling for several months. It had been entirely symptomless.

Examination showed a prominence of the right side of the face in the region of the mandible. On the inside, extending from the mandible upward along the cheek, was a swelling which was slightly tender to palpation. The rest of the physical examination was essentially negative.

Roentgen examination showed a multilocular cystic change in the mandible, extending from the region of the mental foramen well into the ascending ramus. The bone showed evidence of perforation at the inferior border of the jaw (Fig. 239). The diagnosis was multilocular cyst, probably adamantoblastoma.

Fig. 239.—X-ray of multilocular cyst.

On January 29, after the usual preoperative medication, and under endotracheal nitrous oxide, oxygen, and ether anesthesia, an incision was made over the alveolar ridge of the right mandible, and the mucoperiosteum dissected away, exposing a thin cystic wall. This wall was incised, after which a large amount of fluid escaped. The cystic cavity could now be visualized and was seen to extend into the ramus. There was no evidence of tumor. The opening made into the cystic cavity was enlarged by removing bone at the anterior and posterior part of the incision. The cyst membrane was dissected away from the bone with a periosteal elevator. It then became apparent that the mandible was perforated at the lower border, and when the cyst sac was removed, the

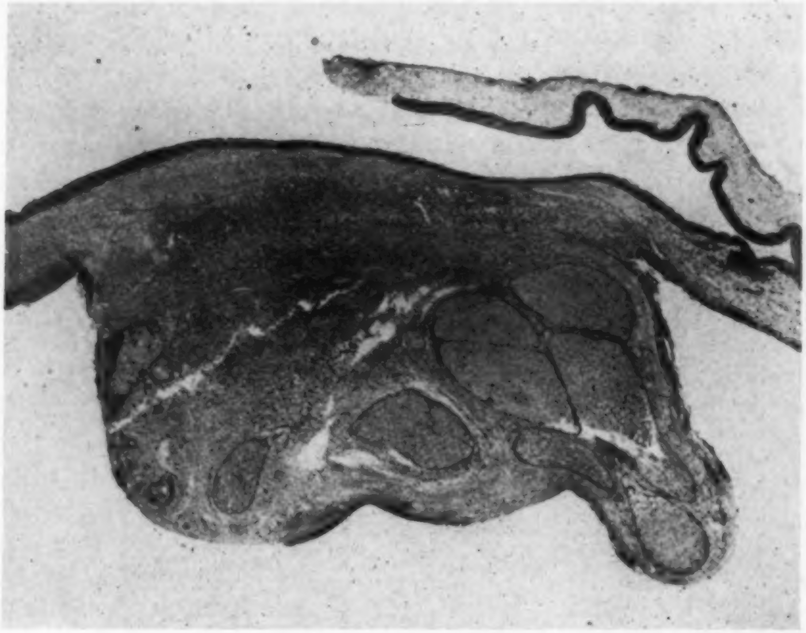


Fig. 240.—Photomicrograph of cyst membrane showing tissue removed from perforation including the mandibular nerve.

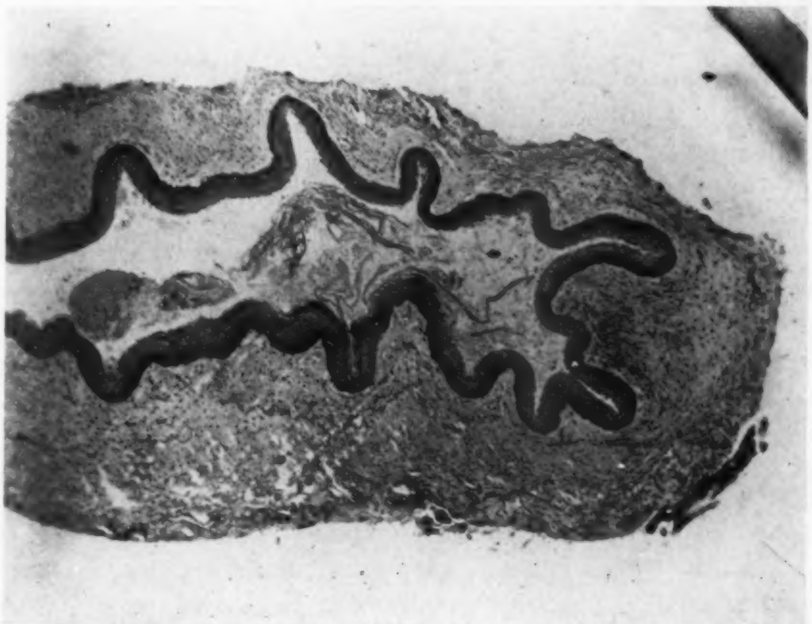


Fig. 241.—Cyst membrane showing well-developed epithelial lining.

mandibular nerve was removed with it. The mucoperiosteal flap was placed into the bottom of the cyst cavity after sulfanilamide powder had been inserted. A boric strip was placed over it to hold the membrane down and occlude the cavity to prevent food from entering.

The specimen submitted for pathologic examination consisted of a membranous piece of tissue measuring 4.5 by 2 cm. traversed by a blood vessel and nerve, and a second piece of tissue, which measured 1 cm. in diameter. The pathologic diagnosis was cyst of the jaw. The cyst was lined by stratified squamous epithelium (Fig. 241), a nerve could be seen attached to it, and there was a scattered infiltrate of inflammatory cells (Fig. 240).

The postoperative course was uneventful, and the patient was discharged on the third postoperative day, February 1, to be seen for treatments until the wound had completely filled in. This occurred on May 6, 1944, when the patient was discharged.

Case 52

Multilocular Cyst

H. W. (No. 450303), a 24-year-old ship sorter, came to the Outpatient Department Dental Clinic on May 13, 1944, complaining of swelling in the right angle of the jaw.

The swelling began three months before, and he was rejected by the Army for this reason. His local dentist told him that the lower right second molar should be extracted to allow eruption room for the third molar, which he thought was causing the swelling. When the second molar was extracted, about one and one-half weeks before the patient came to the Dental Clinic, a considerable amount of "blood" came through the socket. The swelling and soreness was somewhat diminished after this, but the root socket kept draining "yellow material." In the morning he would wake up with a bad taste in his mouth, indicating drainage through the extraction socket.

X-ray examination of the right lateral jaw showed three large cystic areas and at least three smaller cystic areas replacing the normal bone (Fig. 242). There had been marked expansion of the mandible beginning at the region of the second premolar and extending back behind the angle to involve part of the ramus. In one of the loculated cysts there was a 9 by 2 mm. area of increased density which could be tooth structure. Grossly, this had the appearance of a benign lesion. A follicular cyst would receive first consideration. Adamantoblastoma could also produce this picture.

On June 1 the patient was again examined in the Clinic. Since the x-ray showed a condition which might be an adamantoblastoma, a probe was inserted into the socket of the lower right second molar to explore the cavity. This disclosed the fact that the areas in the x-ray were empty rather than filled with tumor. For this reason, a diagnosis of multilocular odontogenic cysts was established, and a conservative operation from an intraoral approach decided upon. Such an operation would furnish material for pathologic study, which should embrace the membrane in each of the compartments.

He was admitted to the House on June 5, for operation on June 6. Local examination revealed a firm, nontender, lemon-sized swelling at the angle of the jaw, apparently attached to the mandible. There was an opening through the tooth socket of the extracted lower right second molar. The oral cavity was otherwise normal. The physical examination revealed a grade 2 systolic murmur which was not transmitted. His blood pressure was 135/80. The rest of the examination was negative.

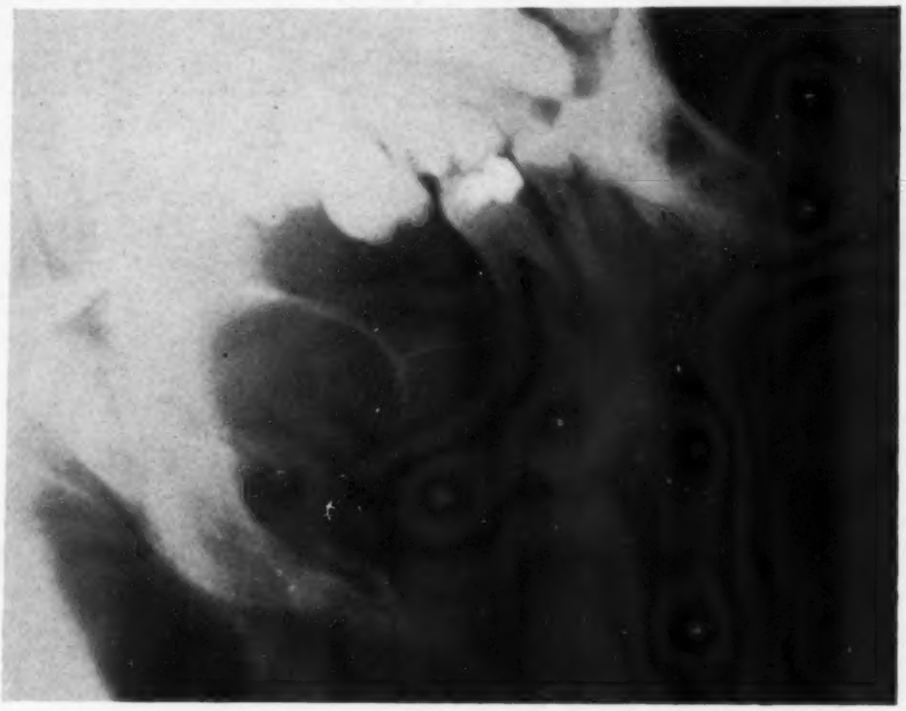


Fig. 242.—X-ray of multilocular cyst.

He was placed on sulfadiazine therapy, and received 2 Gm. to start, 2 Gm. four hours later, and then 1 Gm. every four hours. On June 6, after the usual preoperative medication, and under intravenous pentothal sodium anesthesia with endotracheal intubation, an intraoral incision was made, extending from the coronoid process down the ramus and along the alveolar ridge of the mandible as far as the canine tooth. The mucoperiosteum was detached by means of periosteal elevators, when a thin cystic wall came into view. The first molar and second premolar were extracted, after which the outer and upper wall of the cyst was removed. A large cavity became visible; in it there was very little fluid, since this had escaped through the open socket. Although the cyst appeared to have several compartments in the x-ray, it was found that there was only one cavity of large size with incomplete partitions. The cystic membrane was detached from the bony cavity and was dissected free from the mandibular artery and nerve, which were seen to extend through it and emerge by the mental foramen. The membrane could not be removed in one piece, but was carefully dissected out from each chamber. In some instances it

was considerably thickened. After this, 5 Gm. of sulfanilamide powder were dusted into the bone cavity. The mucoperiosteal flap was then placed over the outer aspect of the cyst containing the nerve and artery, and held by a boric strip which was lightly packed into the cyst. The patient was returned to the ward in good condition.

Several sections were made of the specimen, which showed a fibrous membrane with very few remnants of epithelium found on the surface. One part contained a layer of bone. This was made up of very dense cortical bone from which irregular trabeculae extended into the main part of the cyst. Some round-cell infiltration of the cyst membrane was evidence of inflammatory reaction (Fig. 243).

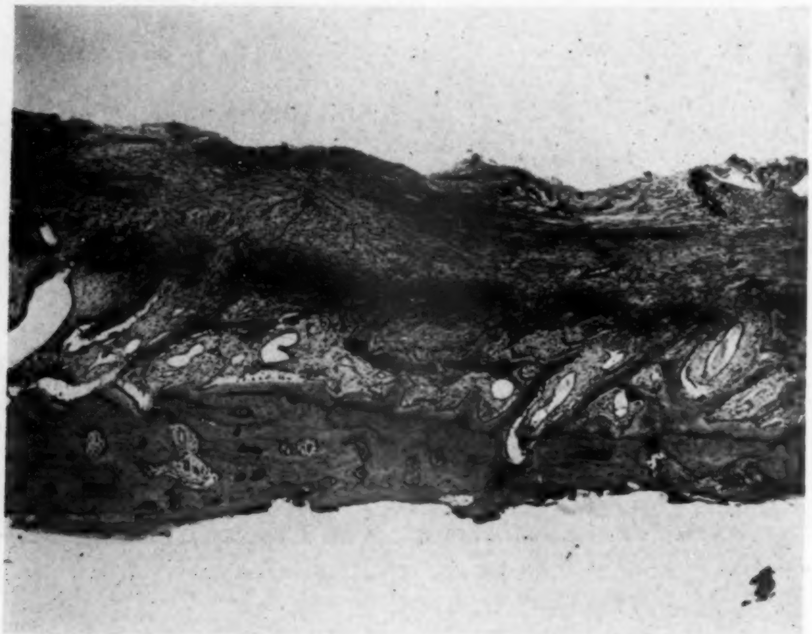


Fig. 243.—Cyst membrane with adjacent alveolar bone.

Postoperatively he did well. His lower lip felt numb. Sulfadiazine therapy was continued. On June 7 the sulfadiazine level in the blood was 4.9 mg. per cent. On June 8, the cystic cavity was irrigated with saline and inspected. The mandibular nerve had been covered by the formation of granulation tissue in the bottom of the cavity. The sulfadiazine therapy was discontinued on June 8, and the patient was discharged, on the third postoperative day, to be followed in the Outpatient Department Dental Clinic.

Here he was seen periodically for irrigations and dressings until the entire cavity was lined with granulation tissue. On June 14, the packing was omitted, and the patient was instructed to clean the cavity after each meal by means of a syringe containing warm saline. When he came to the Dental Clinic on June 26, he was doing well and he was told to come in every two weeks for a checkup.

II. ODONTOGENIC NECK INFECTIONS AND OSTEOMYELITIS OF THE JAW

Neck infections are very frequently of odontogenic origin; in the period covered by this report, thirteen cases were seen in our clinic, of which eight were of odontogenic nature. These infections arise especially from infections of the mandibular molars, not necessarily apical infections of carious teeth, but also periodontal, and pericoronal infections of partly erupted third molars. The infection appears to spread through the lymphatics, in most instances, rather than by direct extension. A case is presented in which the infection was derived from a gingival abscess arising from a carious deciduous molar in a child 7 years of age. That carious deciduous teeth may be the cause of neck infections is not generally recognized, and this case report is added to emphasize this fact by a typical illustration.

The three cases of osteomyelitis have been included because of unusual features, such as, the age of the patient, the method of treatment, and the concurrence of syphilis.

Case 53

Submaxillary Abscess

E. B. (No. 439382), a 7-year-old girl, was first seen in the Surgical Clinic of the Massachusetts General Hospital on Feb. 29, 1944, complaining of a swollen, painful left jaw of twelve days' duration, along with an earache on the left. The condition probably started with a toothache in the left lower deciduous molar. The toothache occurred about a month before and lasted for about two days. The lymph nodes in the left submaxillary region had become swollen several times in connection with colds, but they were not as painful and not as large as now, and there was no discoloration of the skin. A small scar about 2 cm. long, over the lower end of the left sternocleidomastoid muscle, was noted; it was the result of an operation performed when she was 4 years old. She had had measles and mumps, and lobar pneumonia three times, in the past four winters.

The physical examination revealed a large, reddened, hard, tender swelling over the left mandible. This swelling was warm to touch. It extended up to the level of the external auditory meatus and down well below the jaw (Fig. 244). There was tenderness and swelling all along the sternocleidomastoid muscle as far as the clavicle. Inside the mouth, a small gingival abscess was seen on the external surface at the site of the second deciduous molar. The chest examination was negative. She appeared ill and had a rectal temperature of 101° F. Her pulse rate was 128, and her respirations were 32. She was admitted to the Emergency Ward, where her white blood count was found to be 32,000.

X-rays of the jaw showed some caries of the crowns of the second deciduous molar with definite evidence of bone destruction between the roots. A diagnosis of interradicular abscess was made (Fig. 245).

She was transferred to the House, and on March 1 under nitrous oxide, oxygen, and ether anesthesia, with the usual preoperative medication, an incision was made at the angle of the jaw through the skin and platysma, after

Fig. 244.—Seven-year-old child with submaxillary abscess.

Fig. 245.—X-ray showing decayed, infected deciduous second molar.

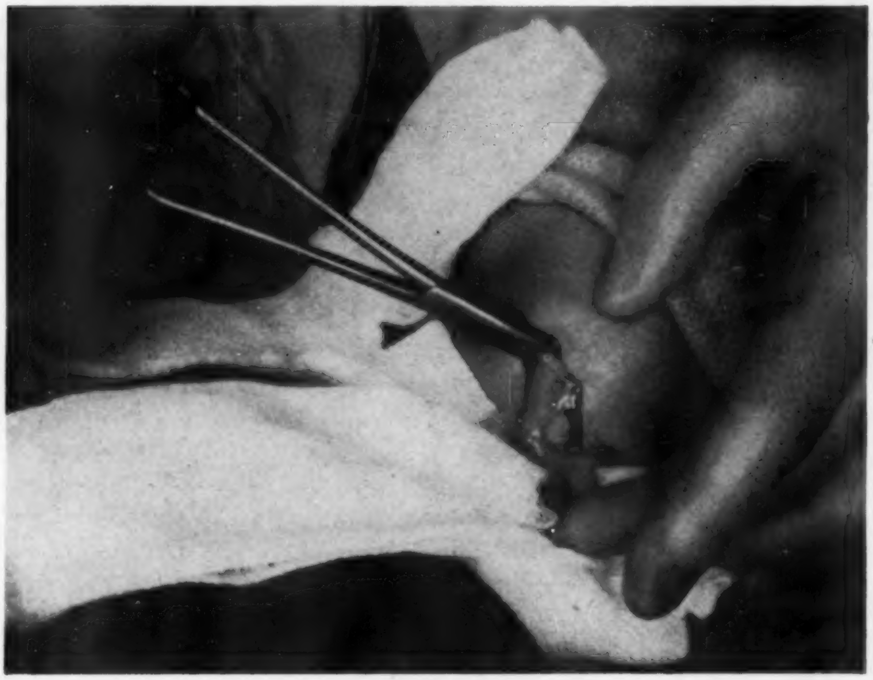


Fig. 246.—Draining of submaxillary space.

Fig. 247.—Rubber dam drain sutured to skin.

which Kelly forceps were inserted into the submaxillary space. About four ounces of white creamy pus were evacuated (Fig. 246), after which a rubber dam drain was inserted into the submaxillary space, and fastened to the skin with two Kaldermic sutures (Fig. 247). A dry dressing was applied. After this, the left lower deciduous second molar was extracted.

Sulfadiazine therapy was instituted on the day before the operation, and was continued until March 6. She was given 2 Gm. to start and 1 Gm. every six hours. On March 2, the sulfadiazine level in the blood was 7.6 mg. per cent.

The cultures made from the pus showed the infection to be due to beta hemolytic streptococcus.

On the first postoperative day, the temperature went down sharply toward normal, and the patient was much more comfortable. She received daily Dakin irrigations, and by March 6 the swelling had partly disappeared. The rubber dam drain had been forced out, and, with the two sutures holding it, was removed. The chemotherapy was discontinued, and the patient was discharged on the fifth postoperative day, after an uneventful recovery, to be followed in the Outpatient Department Dental Clinic. By March 15 there was little swelling left. She was advised to continue home treatment of warm saline mouth washes and warm poultices, and on May 17 she was discharged, relieved.

Case 54

Infantile Osteomyelitis of Maxilla

P. C. (No. 449193), a 9-week-old baby boy, was brought to the Emergency Ward on May 23, 1944. His temperature was 101° F., white blood count 10,800, hemoglobin 90 per cent, and red blood count 5.1. A nose and throat culture was taken. The throat culture was negative for beta hemolytic streptococcus, and the nose culture showed abundant *Staphylococcus aureus,* and pneumococcus, type 13.

X-rays of his chest showed both diaphragms to be low in position. There were linear areas of increased density throughout both lung fields. The heart appeared normal. The findings were consistent with interstitial pneumonia. The impression was that he was suffering from pharyngitis.

On May 25 his temperature was 98.8° F.; his white blood count was 13,700. He was doing well on his formula. There was no respiratory difficulty and his ears, nose, and throat were normal. On May 28, because of a white blood count of 20,000, and persistence of low-grade fever and pneumococcus in the nose culture, the patient was started on sulfadiazine. The dosage was an initial dose of ½ grain per pound of body weight, and then 1 grain per pound of body weight divided into four doses per day. On May 29, the sulfadiazine level in the blood was 4.8 mg. per cent. He was taken off sulfadiazine on June 1. He had been gaining weight, was afebrile, and without signs or symptoms of pharyngitis. He was discharged from the House.

On June 2, the left side of his face started to swell. The next morning pus was discharging from a fistula in the anterior part of the alveolar mucosa. For this reason, he was again brought to the hospital on June 3. Physical examination revealed a temperature of 99° F.; his ears, nose, and throat were benign.

In the mouth, the alveolar ridge appeared normal. The papillae of Stensen's duct were normal. The roof of the mouth was irregular with a deep furrow. There was a slight swelling of the left cheek, and a purulent discharge coming from the upper gum, practically in the midline. A probe inserted through this opening came in contact with a tooth. Following the probing, there was slight bleeding from the left nostril. The nasal airways, however, seemed normal. His white blood count was 15,650, his hemoglobin was 14 Gm., and his red blood count was 4.2. X-rays of the maxillary sinuses failed to show any definite evidence of osteomyelitis. The maxillary sinuses were not aerated.

A culture from the gingival fistula, taken on June 6, showed moderate *Staphylococcus aureus* and few beta hemolytic streptococci. A culture from the roof of the mouth, taken on June 7, showed abundant beta hemolytic streptococcus and few *Staphylococcus albus*, and a throat culture showed abundant beta hemolytic streptococci. The left naris was discharging seropurulent sanguineous material on June 12. The roentgenologist at the Eye and the Ear Infirmary reviewed the sinus films, and he felt that the patient had an osteomyelitis of the left maxilla.

The patient was started on penicillin therapy. On June 13, he received 10,000 units intramuscularly. He was seen in dental consultation on June 14. It was felt that this child doubtless had osteomyelitis of the left maxilla. It was suggested that in addition to intramuscular injections of penicillin, local injections of penicillin into the fistula (500 units per cubic centimeter) every three shoulds should be carried out. It was felt that he might get sequestration of the tooth germ which could be felt with a probe, or that the tooth germ might have to be excised later. On June 14 he received 80,000 units of penicillin intramuscularly, and the parenteral therapy, with the same dosage, combined with the local injections was continued each day until June 20.

A culture taken from the drainage on June 16, showed abundant *Staphylococcus aureus* and few beta hemolytic streptococci. A culture of the left naris was negative for beta hemolytic streptococci.

The intramuscular injections of penicillin were discontinued on June 20, but irrigations of the sinus tract were continued, and reduced to four each day. On June 25, the soft tissue swelling over the left maxilla had receded greatly and it became much more difficult to insert the blunt needle into the sinus tract for injecting the penicillin, and less purulent material was coming from the patient's nose.

The roentgenologist at the Eye and Ear Infirmary, on June 28, felt that newly taken x-rays showed no further bony destruction. He pointed out some destruction in the maxilla where it joins the nose, but did not see any visible involvement of any tooth germ.

On July 3, the patient had a normal mucosa which indicated healing of the sinus tract, and it was felt inadvisable to interfere with the tooth buds at this time. The nose and throat cultures were negative for beta hemolytic streptococci and pneumococci. *Staphylococcus albus* predominated in the nose culture. By July 5, he was afebrile. The patient was discharged relieved on July 19, 1944.

Case 55

Chronic Osteomyelitis of the Mandibular Ramus Treated With Penicillin

A. A. (No. 436989), a 39-year-old man, was first seen on Feb. 7, 1944, because of an apparent osteomyelitis of the right mandible.

About a year ago the patient began to feel fatigued and listless. He was easily irritated, and had trouble sleeping. His general malaise continued until warm weather arrived, at which time he began to feel a little better. However, through June and early July of 1943, he lost about 20 pounds. He went to his local doctor, who advised him to have his upper teeth removed because of dental infections. This was done late in July, 1943, but he continued to be in poor health. He was finally advised by his company physician to take a vacation. By the end of August while still on his vacation, he was feeling better until he awoke one morning, after several days of overactivity, with the right side of his face swollen. It was not painful, and the swelling decreased after two days, only to recur again with pain. He returned home, where the pain and swelling increased. His condition was diagnosed as mumps by both his local doctor and the company doctor, and he was told to go to bed. A day or so later he "went out of his head" for a few hours, and his local doctor advised hospitalization at a near-by hospital. Four days after entiry there "an abscess opened up" inside his mouth in the mucobuccal fold outside the alveolar ridge of the upper jaw, and continued to drain. He was started on sulfonamides, which were given for a period of two weeks, while flaxseed poultices were applied to the swollen area. Eleven days after entry his temperature returned to normal and the swelling decreased. He was sent home where he was kept in bed, but about two weeks later his face began to swell again, and three weeks after his hospital discharge "another abscess broke" and continued to drain into his mouth. Sulfonamides were again started, and continued for another two weeks. X-rays of his jaw were taken which showed "nothing." About a week later more x-rays were taken, and the patient was advised to have a sequestrectomy, which was performed on Oct. 12, 1943. After two weeks he returned home improved, only to have his face swell up again about three weeks later. This time the "abscess" was drained externally, and a tube was left in the wound for ten days. This wound had been draining ever since. Periodic x-rays had been taken since his first operation, which revealed nothing new. Another two weeks' course of sulfonamides was given late in January, and finally he was advised to come to the Massachusetts General Hospital where he was seen in the Outpatient Department. Arrangements were made for his early entry into the House for further treatment.

On examination the patient presented a swelling in the parotid region with a draining sinus at the angle of the mandible (Fig. 248). The right side of the face was swollen and tender to touch; he could not open his mouth more than $\frac{3}{4}$ inch. In addition, the physical examination revealed expiratory "purring" râles over the whole lung field, a soft blowing systolic murmur, and a few rare extrasystoles.

X-rays of the jaw taken on February 7 showed "an irregular fragment of bone lying close to the ascending ramus of the mandible, and an area of

rarefaction in the mandible at the mandibular notch. The findings could well be due to osteomyelitis of a rather chronic type."

A probe was inserted into the fistula, and x-rays were again taken of the right jaw. The report stated that "the probe extends along the lateral margin of the right mandible in the direction of rather dense bone (Fig. 249). This dense bone has the appearance of a sequestrum or partially destroyed cortical bone of the ascending ramus. The findings are consistent with osteomyelitis connected to the outside by a sinus tract."

A culture was taken which showed a growth of *Staphylococcus albus,* sensitive to penicillin. Penicillin was applied for and received. Intramuscular injections of 2 c.c., containing 5,000 units per cubic centimeter, were started and continued every three hours.

Fig. 248.—Fistula with pus discharging.

The patient was admitted to the House on February 15. His white blood count was 7,000 and his red blood count was 4,600,000. On February 17 the usual preoperative medication was given, and under pentothal sodium intravenous anesthesia an incision was made at the lower border of the mandible at the site of the fistula. Some white appearing pus was evacuated while pressure was applied over the ramus. The submaxillary space was inspected, and there was no abscess there. A Kelly forceps was inserted into the fistula, approximately as far as the mandibular notch, and the fistulous tract was dilated by opening it. A Dakin tube was then placed as far up as the mandibular notch, where it could be felt underneath the skin, and was attached at the incision by means of a silk suture, after which the incision was plugged with

sterile gauze (Fig. 250). The tube was passed underneath the chin to the other side where it was fastened to the cheek with adhesive tape for local application of penicillin in a solution of 500 units to 1 c.c. The penicillin was injected every three or four hours. In addition the intramuscular injections were continued.

Fig. 249.—X-ray with probe inserted into fistula to the mandibular notch.

On February 18, the first postoperative day, his condition was good. The incised area was slightly swollen, and his temperature rose to 100.3° F. The culture report taken from drained pus on February 19 showed *Staphylococcus albus,* nonhemolytic streptococcus, and a weak growth of *Staphylococcus aureus.* On February 21 the patient had an area of induration extending from the angle of the right mandible to the zygoma on the same side. On this morning he could not move his jaw because of trismus. The culture taken on this day revealed *Staphylococcus albus* and nonhemolytic streptococcus. The next day his condition was improved, and only mucoid discharge was present. The culture taken on February 24 still showed *Staphylococcus albus* and nonhemolytic streptococcus. On February 26 he received a transfusion of 500 c.c. whole blood. He had another x-ray taken the next day which showed clearly a sequestrum near the mandibular notch (Fig. 251). On March 1 he was seen at

Osteomyelitis Rounds, where it was advised that a sequestrectomy be done. In preparation for the operation the patient received another transfusion of 500 c.c. whole blood.

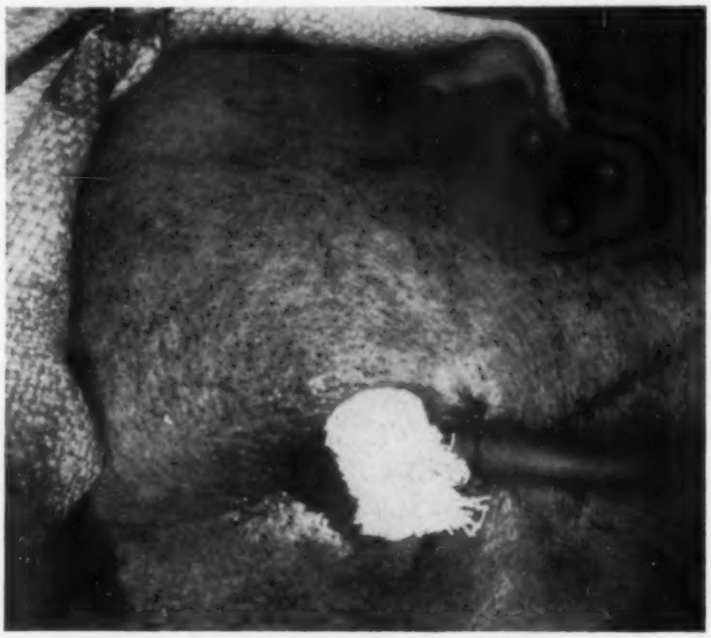


Fig. 250.—Dakin tube inserted into fistula and sutured to skin. Gauze is packed around the tube to prevent the penicilin from escaping.

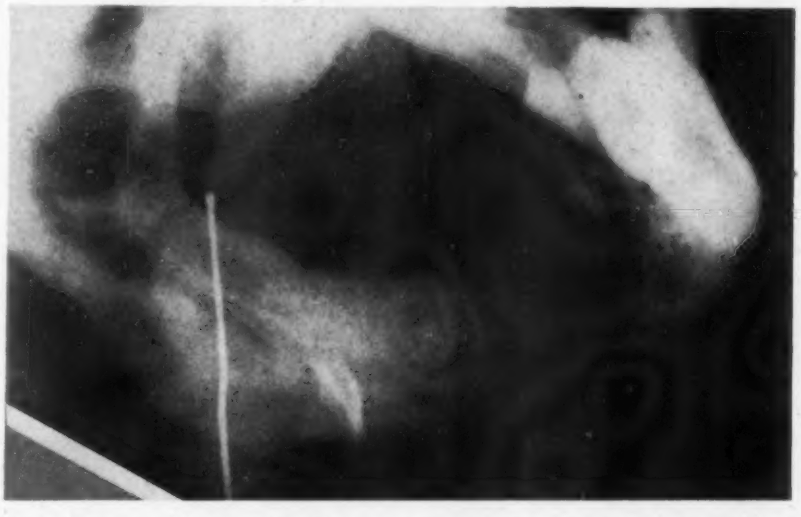


Fig. 251.—Lateral x-ray with probe inserted showing a sequestrum below the mandibular notch.

The operation was performed with the usual preoperative medication, under intravenous pentothal sodium anesthesia. A vertical incision was made in front of the ear, extending downward as far as the attachment of the lobe. The subcutaneous tissue was divided, and the transverse facial artery cut and tied. The neck of the condyle and the ramus was exposed to the mandibular notch. Here the sequestrum could be felt moving around. It was grasped with a small

Kelly forceps, cut away from some muscular attachment, and removed through the incision (Fig. 252). The Dakin tube was then reinserted into the fistula at the angle of the jaw in order to continue the local injections of penicillin into the affected area. The incision in front of the ear was closed, after placing sulfanilamide powder into the wound. A subcuticular suture was used. The postoperative x-ray is shown in Fig. 253.

After the operation, during which he received 1 Gm. of pentothal sodium, he was unconscious for seven or eight hours and was violently active for a half hour, requiring restraints. His blood pressure and respiration were constant.

On the first postoperative day he had another transfusion of 500 c.c. whole blood. On the second postoperative day, the temperature chart was flat, and he was comfortable. The incision was apparently healing well. Cultures taken on the third postoperative day showed no growth. The Dakin tube was removed and penicillin discontinued on the fifth day after the second operation and the twenty-first day after beginning the treatment.

On March 10 some swelling was noticed at the site of the incision in front of the ear, and it was felt that this should be incised and drained. The usual preoperative medication was given, and under nitrous oxide and oxygen anesthesia an opening was made at the lower end of the incision in front of the ear. Pus was encountered. The fistulous tract was enlarged with a small Kelly forceps, and a short Dakin tube inserted for local penicillin treatment after a culture had been taken. He was again placed on intramuscular injections of penicillin. The aerobic culture showed no growth, and the anaerobic culture showed diphtheroids. The Dakin tube was taken out on March 12, when the dressing was changed. A rubber dam drain was inserted instead, and injections of penicillin were continued by means of a syringe. The patient was comfortable, and the swelling was considerably reduced, although the incision was still draining some pus. The suture and rubber dam drain were removed on March 15, when the wound was irrigated with zephiran.

By March 20 he was feeling much better and his mouth could be opened wider. There was practically no discharge, and the swelling was almost gone. The patient was instructed in exercises to stimulate jaw action. He was given a transfusion of 250 c.c. whole blood on March 18, and again on March 23. On March 23 he was discharged, to be followed in the Outpatient Department.

He remained very comfortable, but occasionally there was some mucoid discharge from the fistula at the angle of the jaw. On April 6 he again had a slight flare-up accompanied by some swelling of the face and some discharge. A culture was taken on April 6, and the bacteriologist reported that there was a filament present which, on further culture, was thought to be due to fungus actinomycoses. A culture made from a small amount of pus taken from the jaw on April 11 showed *Staphylococcus albus,* but there were no sulfur granules found. The fistula was then irrigated with zephiran for several days, after which the patient was asymptomatic. He was advised to return to work.

The patient kept having swellings, however, and when he was seen on June 9 an x-ray was taken which showed another sequestrum of the ramus,

below the mandibular notch (Fig. 254). He was again admitted to the House for a sequestrectomy.

On July 18, under nitrous oxide, oxygen, and ether anesthesia, and with the usual preoperative medication, an intraoral incision was made in the mucosa on the anterior border of the ramus. The periosteum was incised, and the masseter muscle retracted. Probing by means of a bone file disclosed a loose fragment which was removed. There was very little evidence of infection or inflamma-

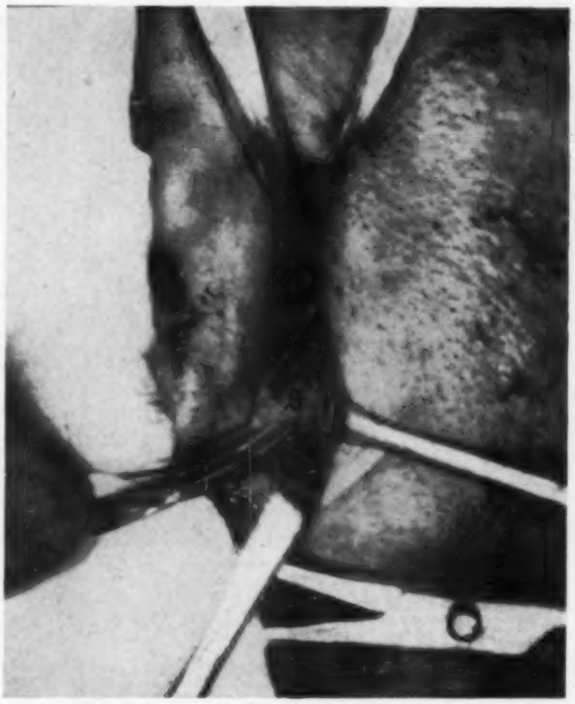


Fig. 252.—Incision in front of the ear through which the sequestrum (*S*) is being removed.

Fig. 253.—Lateral x-ray showing mandible after the sequestrum was removed. The two white points are the leads holding the subcuticular suture.

tion. A boric strip was inserted into this incision, and after dilating the fistula extending from the angle of the jaw to this area, a Dakin tube was inserted into it as far as the place where the sequestrum had formed.

The bacteriologic examination showed abundant *Staphylococcus aureus,* the growth of which was inhibited by 0.02 units of penicillin per cubic centimeter, growth occurring with a dilution of 0.006 units of penicillin per cubic centimeter.

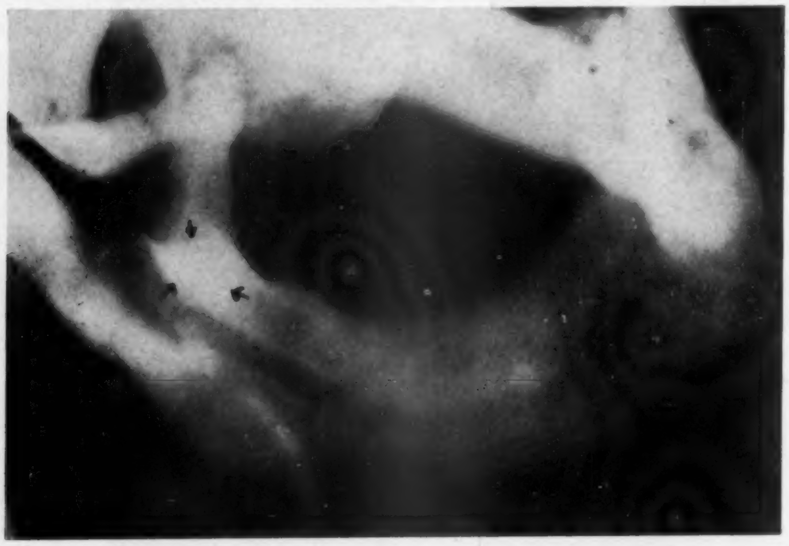


Fig. 254.—Lateral x-ray showing a new sequestrum on the outer side of the mandible below the mandibular notch.

The patient was again put on penicillin intramuscular injections (96,000 units per day) given every three hours. In addition, local injections were given in a dilution of 500 units per cubic centimeter through the Dakin tube. The postoperative trismus and swelling subsided rapidly. A new bacteriologic examination on July 24 showed moderate *Staphylococcus aureus.* The intraoral drain was removed on the second postoperative day, and the Dakin tube was removed on the seventh postoperative day. Penicillin was then injected by means of a cannula.

Penicillin therapy was discontinued on August 7, and the patient was discharged from the House on the same day, relieved.

Case 56

Osteomyelitis Associated With Syphilis

P. L. (No. 439835), a 50-year-old man, came to the Emergency Ward on March 11, 1944, with osteomyelitis of the right maxilla in the cuspid region.

Three weeks before, he had a slight swelling in the mucous fold in the region of the right upper cuspid. The central incisor was sore to percussion and so loose that it was removed without anesthesia. After two days there was a purulent discharge from the alveolus, and the lateral incisor was removed, it also

being quite loose. X-rays at this time showed slight disintegration of bone, but no circumscribed area. Dressings were placed in the alveoli of the missing teeth, but there continued to be a heavy purulent discharge. The swelling recurred, and an incision was made about eight days after the removal of the central incisor. Iodoform drains were placed and changed daily with irrigations. There had been no change in the amount of heavy frank pus discharge since. On the contrary it increased, with swelling occurring on the palate in the midline. This area was also incised and drained. Two Kahn serologic tests had been made recently, which were reported to be positive. It was obvious that the patient had unsuspected syphilis at the time of his dental extractions, and, therefore, he was referred to this hospital. The condition at this time is shown in Fig. 255.

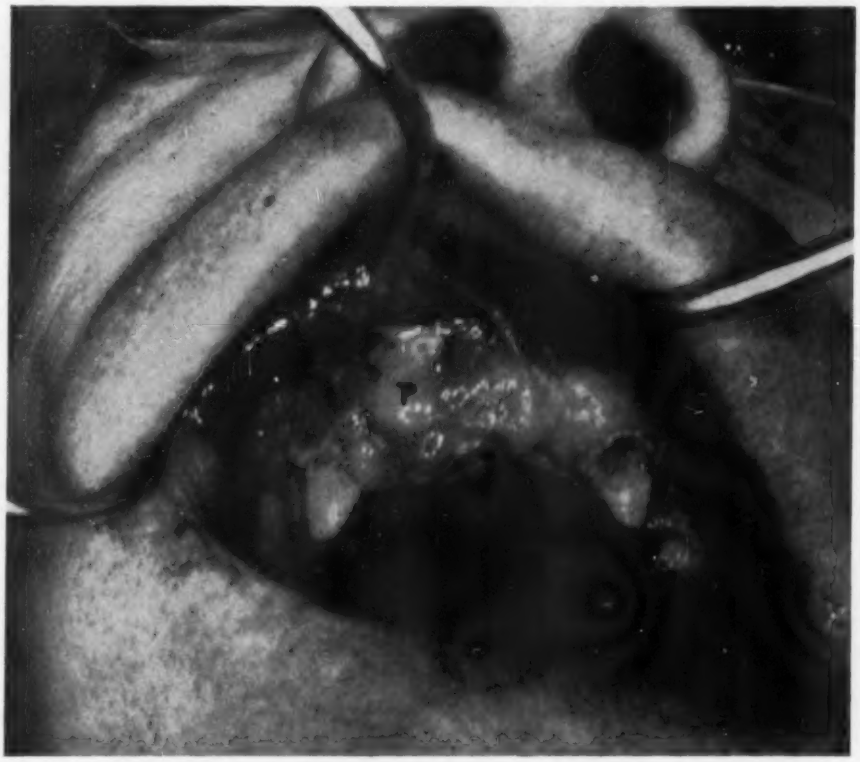


Fig. 255.—Pus (*P*) discharge from fistula in the edentulous part of the upper jaw.

The Dental Department felt that the osteomyelitis probably would not respond until the syphilitic condition was treated. Local treatment with warm hydrogen peroxide rinses was advised, however, and applications of 2 per cent gentian violet painted on the gingiva were prescribed.

The history disclosed that he had had a chancre in 1917 for which he had inadequate treatment. In 1930, he complained of blurring vision and staggering. His pupils were uneven and irregular. The Romberg sign was negative. The spinal fluid cells were 92, and the gold solution was 1122110000. He received treatment during 1930 and 1931 but had had no treatment since.

Examination on April 22, 1944, disclosed that his pupils were fixed to the light, and that the spinal fluid gold solution was 5555522100. The impression was that he had very early tabes and questionable paresis. In addition, many asthmatic râles over the chest were heard, resulting from recent bronchitis; he had a Grade 1 systolic murmur, heard best over the apex. A moderate left direct hernia was discovered. Bismuth treatment was recommended.

X-rays of the skull were made on April 25. Those from the Waters position showed probable pus in the left antrum. The right antrum appeared clear. There appeared to be a perforation extending from the incisor area into the right antrum, but this was not definite.

He was admitted to the House on May 11, 1944, for treatment of his osteomyelitis. X-rays of the jaw taken on the day of admission showed what appeared to be a defect in the anterior portion of the maxilla, with resorption of bone about the margin (Fig. 256).

Fig. 256.—X-ray showing osteomyelitis of maxilla.

He was given sulfadiazine therapy, 2 Gm. to start and 1 Gm. every four hours. On May 12 after the usual preoperative medication, under nitrous oxide, oxygen, and ether anesthesia, a saucerization and sequestrectomy was performed. An incision was made on the alveolar ridge of the upper jaw extending anteriorly from the midline to the molar region. The incision at each extremity was extended upwards on the outer part of the jaw. When the mucoperiosteal flap was detached from the bone and retracted, a sequestrum came into view which seemed to be completely separated from the bone and showed dark discoloration. This was taken to be due to the bismuth injections which the

patient had had. A second sequestrum was located in the anterior part of the maxilla and removed also. After this, sulfanilamide powder was dusted into the wound and a boric strip inserted into the cavity in the bone.

The postoperative course was uneventful, and the patient was discharged on the third postoperative day, May 15, to be followed in the Outpatient Department. On May 17 the pack was removed, the cavity irrigated with Dobell's solution and lightly packed with borated iodoform strips.

The pack was changed and the wound irrigated on May 19, 24, and June 7. On June 21 the wound was filling with granulation tissue.

III. FRACTURES OF THE JAWS

Of the fractures seen in the first half of 1944, suitable cases were again selected for treatment with some of the methods developed recently. The use of internal wiring fixation to immobilize a section of the maxilla is illustrated in Case 57. This is a new application of a method described recently for immobilization of the mandible (Thoma, 1943). Internal wiring fixation, condemned for mandibular fractures by many writers on this subject, has been used again in a number of instances because it gave satisfactory results in cases reported in *Massachusetts General Hospital Number II*. We had occasion to remove the wires used for fixation of the ramus fracture (Case 46) and the comminuted fracture (Case 30), because we feared that they might cause irritation when the patient was given dentures. We found the wires as clean and shiny as when they were inserted; they were covered by connective tissue, and there was no evidence of irritation or inflammation present. After removal, the wounds healed by first intention. We believe these good results with interosseous wiring are due to two factors: first, the use of stainless steel which appeared to be biologically inert; and second, the fact that the wire is used only to retain the fragments in the reduced position so that they cannot be displaced by muscle pull, and not for fixation of the fracture. In every case the mandible was, in addition, immobilized by intermaxillary ligation or the use of a splint.

Many condylar fractures were seen during the period covered by this report; the incidence was 40 per cent of all mandibular fractures; 3 patients presented bilateral fractures, 5 patients unilateral ones, of which 4 were on the left, 1 on the right; 5 were in men and 3 in women. Since the experiments with closed reduction, with intraoral and external traction, did not bring forth a method by which the overriding at the neck of the condyle could be overcome, a method to be described in a special communication was developed, by which the fracture can be accurately reduced and fixed by internal wiring. Two of five cases treated by this method will be described. Some condylar fractures are complicated by dislocation. A new application of skeletal fixation, useful to immobilize the condyle after the dislocation has been reduced, will be described. The patient presenting the fracture dislocation was treated before the internal wiring method had been developed. Today we would use, in addition, an interosseous wire to fix the fracture of the condylar neck. In one patient (Case 60) the condyle was wired on one side, and excised on the other because it was dislocated and comminuted. The last case presented is a fracture com-

plicated by osteomyelitis, which was successfully treated by means of skeletal fixation and penicillin therapy. The patient made an uneventful recovery, with clinical union occurring in the length of time usually consumed for the healing of a simple fracture.

Case 57

Pathologic Fracture of Maxilla Complicated by Cyst

H. R. (No. 446560), a 31-year-old man, presented himself at the Dental Outpatient Department on May 1, complaining of a loose, painless mobility of a fragment of the maxilla extending from cuspid to cuspid.

Ten days before, he had been in an automobile accident in which his ankle, anterior chest, and face were injured. A fractured fibula was diagnosed at an outside hospital, and his leg was put in a plaster cast. The blow on the face loosened the two left upper incisors. There had been no bleeding from the mouth.

The physical examination revealed a slight enlargement over the left sterno-clavicular joint. There was a grade 2 systolic murmur heard at the apex, tricuspid, and pulmonic areas. He said that he had been classified 4F by the Army because of "moderate neurocirculatory asthenia."

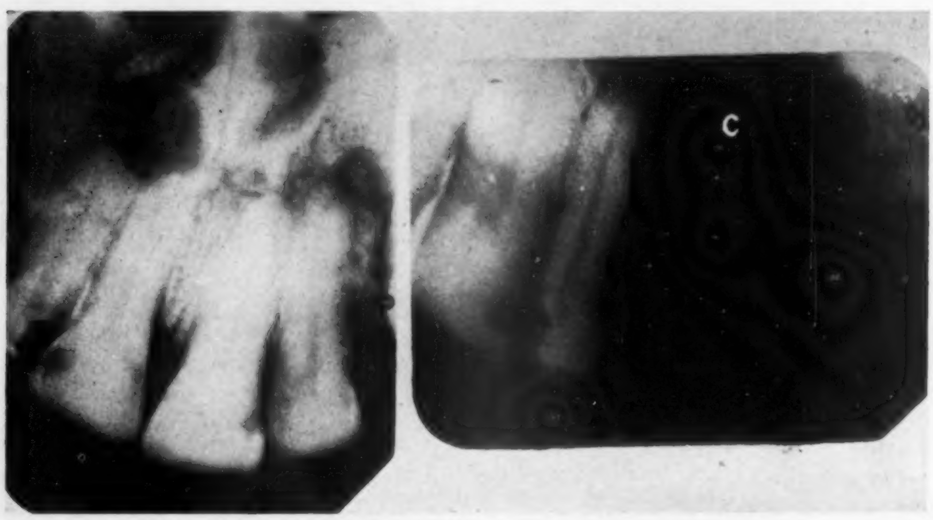


Fig. 257.—Dental films showing a fracture over the apices of the maxillary incisors and an adjacent cyst (*C*).

X-rays taken on May 1 showed a cyst on the left, posterior to the second incisor in the premolar area, and a fracture extending over the apices of the incisors and into an abscess about the right canine tooth (Fig. 257). He was given a House admission, on May 4, for reduction of the fracture.

On May 5, after the usual preoperative medication, the patient was given nitrous oxide, oxygen, and ether anesthesia for excision of the cyst and wiring of the fracture. The mucosa over the cyst was incised and the mucoperiosteum retracted. After removing some bone the cyst membrane was exposed, which could be detached and removed in one piece. On the right side the infected,

Fig. 258.—Arch wire placed external to the dental arch. The steel wires pulled through the margin of the pyriform aperture of the nose and looped around the arch wire (arrows) are holding the segment up.

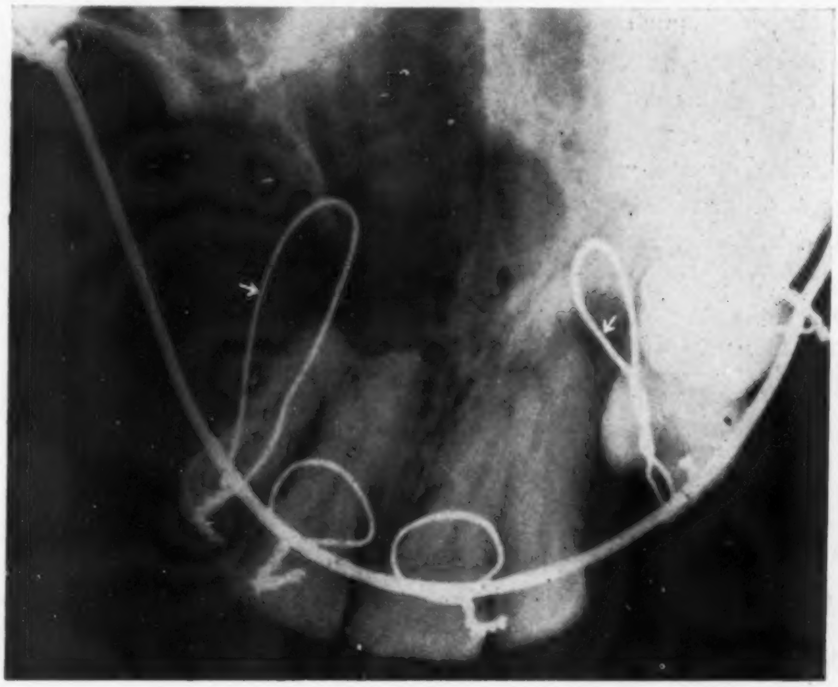


Fig. 259.—X-ray showing wires from pyriform aperture to the arch wire (arrows).

decayed canine tooth was removed. The fractured segment of the upper jaw now contained four teeth, and although the fracture extended very close to the apices, it was thought best to retain the teeth as well as the fractured bone. In case the teeth should be found nonvital later, it was felt that they could be removed better when the fracture had healed, since removal at this time would endanger the retention of the fragment of bone.

It was felt that this fragment could be immobilized by internal wiring fixation. A German silver wire was shaped to fit outside the dental arch and was attached to all the teeth by means of stainless steel wire. This fixed the segment in an anteroposterior direction, and in order to hold it in contact with the remainder of the upper jaw, stainless steel wires were hooked into holes drilled each side through the margin of the piriform aperture of the nose by means of incisions made in the reflection of the labial mucosa. These two wires were then passed beneath the mucosa so that they emerged at the gingival margin where they were attached to the arch wire previously described. The incisions were closed with silk sutures (Fig. 258). The occlusion was tested, and it was found that the teeth were in good apposition and alignment, and that the fragment was firmly fixed.

The postoperative x-ray showed the fragments well reduced and held in contact by an arch wire and internal wiring fixation (Fig. 259).

The patient had an uneventful postoperative course and was discharged on March 8, the third postoperative day, to be followed in the Dental Clinic of the Outpatient Department.

On May 10 there was slight swelling at the base of the upper lip, but there was no pain or discharge of pus. The four silk sutures were removed on May 17. His mouth hygiene was poor because he was afraid of harming the appliance. His mouth was thoroughly cleaned with the power spray. He was seen again on June 8. His fracture had not improved very much; the maxillary segment was still quite loose due to trauma caused by the lower teeth pressing into the upper ones. A splint was constructed and inserted to open his bite and eliminate completely intermaxillary contact in the incisor region. He was asked to return in two weeks. At this time the fracture had started to unite and was quite firm.

Case 58

Fractured Mandible With Displacement of Posterior Fragment

L. O'R. (No. 438202), a 26-year-old housewife, was admitted to the House on Feb. 28, 1944, with a diagnosis of "fractured mandible."

Two months before, she tripped over a rug and fell on her face, striking her chin. After this fall there was no tenderness or swelling. About three weeks ago, she again tripped and fell, striking the left side of her mandible. At that time she spit a little blood and suffered considerable pain, but she had no headaches, no bleeding from the nose or ears. Tenderness and swelling just distal to the angle of the left side of the mandible developed during the next few hours. X-rays taken by a dentist revealed a fracture.

Two days later she came to the Massachusetts General Hospital Outpatient Department Dental Clinic where the diagnosis was confirmed by x-ray. She was referred to the House on February 28.

She had little soreness or pain in the mandible at this time but suffered much pain in the lower left second molar tooth. There was no special impairment of the ability to move her jaw, and she could chew adequately on the right side. Her speech had been somewhat slurred since she suffered her fall.

On examination, the left side of the cheek, just distal and slightly above the angle of the mandible, was seen to be slightly swollen. The left side of the tip of the chin and lip was slightly numb to tactile stimulation. The motions of the jaw were only slightly limited. The teeth were in very bad shape, and the breath was foul. The lower left second molar tooth was raised and occluded with the upper molar while anteriorly the bite was open. The remainder of the physical examination was entirely negative, except for a somewhat deformed left fourth finger due to a fracture received less than a year before.

Fig. 260.—X-ray showing fracture at the angle of the jaw with displacement and involved second molar.

The roentgen examination revealed an oblique fracture at the angle of the jaw, the posterior fragment containing a molar tooth which seemed to be involved by the fracture and was somewhat displaced so that the molar occluded while the rest of the mandible was in open position (Fig. 260).

After the usual preoperative medication, the patient was anesthetized with nitrous oxide, oxygen, and ether. An incision was made at the angle of the jaw about 1 cm. below the inferior border of the mandible. The platysma was divided and the external maxillary artery and vein cut and ligated. The periosteum was then incised and the fracture exposed. There was about 1 cm. displacement of the ramus in an upward direction. While holding the fragments

with bone forceps, a hole was drilled into each about 0.5 cm. away from the fracture and the same distance from the inferior border of the mandible. Through these holes a 25 gauge stainless steel wire was inserted. After reducing the fracture, the wire was twisted, cut, and bent into the fracture line.

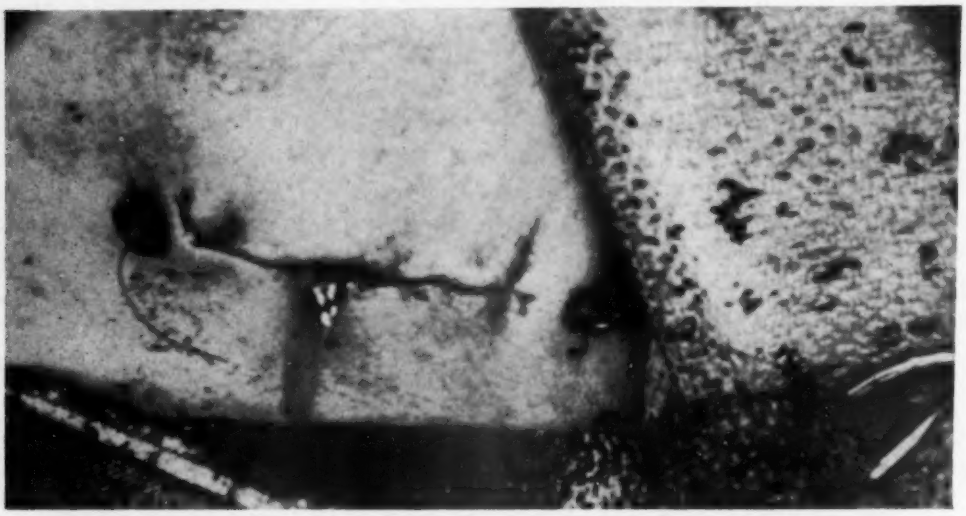


Fig. 261.—Incision is being closed by a subcuticular suture. Rubber dam drain inserted.

Fig. 262.—Postreduction x-ray showing internal wiring fixation.

Sulfanilamide powder was inserted, the subcutaneous tissues closed with catgut, and the skin with a subcuticular Kaldermic suture. A rubber dam drain was placed through the incision to be in contact with the fractured bone. (Fig. 261.)

X-rays taken on March 2 showed a wired fracture in the posterior portion of the horizontal ramus of the mandible. There was a moth-eaten appearance

to the margins of the fracture line, probably caused by the extraction of the molar tooth. The fragments appeared to be in good position (Fig. 262).

Her postoperative condition was good. She was put on sulfadiazine therapy, 2 Gm. to start, and 1 Gm. every four hours until her discharge from the hospital. By March 3 the sulfadiazine level in the blood was 9.2 mg. per cent. An intraoral splint was constructed for additional fixation of the mandible. This aided in obtaining good occlusion, which was maintained with a tight Barton bandage. On March 8 the sutures were removed and the area painted with iodine. The incision appeared well healed. Strict instructions were given her about good oral care at home and the importance of not removing the bandage. She was discharged on the eighth postoperative day, after an uneventful hospital course, to be followed in the Outpatient Department.

When the patient was next seen on March 13, she had removed the Barton bandage at home without permission. She was comfortable but uncooperative. She was given strict home care instructions, and the necessity of retaining the Barton bandage was emphasized.

Case 59

Compound Multiple Fracture of the Mandible

J. M. (No. 438269), a 28-year-old housewife, was brought to the Emergency Ward by ambulance on Feb. 24, 1944. She was found to be suffering from a compound fracture of the right femur, a subtrochanteric fracture of the left femur, a deep laceration on the anterior surface of the left knee which laid open the joint, lacerations over the left eyebrow, nose, and lip, compound multiple fractures of the mandible (Fig. 263), fracture of the left inferior pubic ramus, and probably a ruptured bladder.

She had been a passenger in an automobile driven by her husband and containing seven people. The automobile crashed into an overpass abutment at high speed while the driver was trying to elude the police. The patient's husband, baby son, and daughter aged 7 years were killed. One son, 5 years old, was injured and also brought to this hospital. Another passenger, a friend, died on arrival at the hospital.

The patient did not lose consciousness after the accident. On arrival at the hospital, she was given a transfusion of 1,000 c.c. whole blood. Her name was immediately placed on the danger list.

On February 25 open reduction of the right femur with plating was performed. The prevesical space was explored, and a Kirschner wire was put through the femur. The right leg was then put in balanced suspension traction and the left leg in Russell fixation. The lacerations of the face were sutured and temporary horizontal wiring fixation applied to the jaw. On February 25 sulfadiazine therapy was instituted. She received 4 Gm. on the first day and then 1 Gm. every four hours. She also received intravenous plasma and glucose.

The patient was seen in dental consultation; examination showed a compound fracture of the anterior part of the mandible, and a possible fracture of one or both mandibular condyles. The fracture in the anterior part of the

mandible showed considerable displacement. The bone fragments were visible from the outside as well as from within the mouth. Temporary fixation was thought to be indicated as soon as her general condition would allow.

A cardiac consultation showed essentially regular rhythm with many extrasystoles and compensatory pauses. There was no sign of cardiac decompensation. She developed pericardities, doubtless traumatic in origin, on February 26. No extrasystoles could be heard at this time. That evening her temperature was 101° F., pulse rate 140, and her lungs were clear. She was given an intravenous injection of 2,300 c.c. containing saline, vitamins, 5 Gm. sulfadiazine, and 1 ampule of calcium lactate. The next day her temperature was normal. Her pulse was still rapid, but less (110) and not as forceful. Sulfadiazine was continued, 1 Gm. every four hours.

On February 28 there was no evidence of any intracranial lesion. Plating of the left femur was carried out on March 6. She was put in a bilateral spica cast. She was given a transfusion of 500 c.c. whole blood. The sulfadiazine level in her blood was reported to be 3.5 mg. per cent.

X-rays taken on March 8 showed a fracture in the region of the symphysis of the mandible, and bilateral fracture of the neck of the condyles of the mandible. On the left there was lateral displacement of the ascending ramus, and overriding of the fragments. On the right there was a fragment of bone lying medial to the neck of the ramus. It was felt that it might represent the head of the right condyle since the latter was not seen in its normal position. (Fig. 264.)

For the past two days she had been running a rectal temperature of 101° F., and had complained of pain in the calf of the left leg. Physical examination showed that the lungs were clear. There was minimal pitting edema of the left ankle with less on the right. Homan's sign was negative. Her urine was loaded with white blood cells. The diagnosis was cystitis and a question of thrombophlebitis. X-rays of the chest were interpreted as "resolving infarct of the right costophrenic angle."

On March 14, under local anesthesia, bilateral superficial femoral vein ligations were performed, and, at the same time, rubber band traction was applied to the lower jaw by means of Kazanjian buttons which were attached to both upper central incisors, canines, and lower first premolars and molars. The elastic bands, which were attached in an oblique fashion, were expected to draw the mandible forward and into occlusion (Fig. 265), and to correct the displacement at the line of fracture where considerable callus had already formed. Her occlusion was good on March 20, when the rubber bands were changed. Her jaw was comfortable.

On March 28 an open reduction of the fracture of the neck of the condyle on the left was performed. The patient was seen in consultation with the Anesthesia Department, and it was the general opinion that since she had been anesthetized with ether repeatedly, there would be less probability of vomiting postoperatively if intravenous pentothal sodium anesthesia with an intratracheal tube were used after induction of anesthesia. An angulated vertical incision was made in front of the left ear. The superficial orbital artery and vein were ligated and cut. The dissection was carried down to the zygomatic

Fig. 263.—Patient with compound multiple fracture of the mandible and lacerations of the face.

Fig. 264.—Anteroposterior x-ray showing on the left a fracture of the neck of the condyle (*C*) and on the right a comminuted fracture of the condyle (*C*) with dislocation.

arch and after dividing and ligating the transverse facial artery to the mandibular fragment, the edge could just be seen at the end of the incision limited by the facial nerve. The condyle was found to be displaced medially, and there was considerable overriding. After pushing the mandibular fragment up into the incision, a hole was drilled obliquely, using a protective guide to prevent injury to the tissue. A wire was then inserted into this hole. The fractured end of the condylar process was then located and, by means of a bone file and leverage, brought outside of the mandibular fragment. A hole was now drilled into the condylar fragment, through which the wire was passed (Fig. 266) and the ends twisted together after the fracture had been impacted. The wire was cut off and bent close to the fracture line. Sulfanilamide powder was dusted into the wound, and the subcutaneous tissues were closed with catgut sutures and the skin with a subcuticular suture, after inserting a rubber dam drain to prevent a hematoma from forming. A pressure pack was applied and held in position by an Ace bandage.

The dressing was changed and the drain removed the next day. On March 30 the incision looked good and was apparently healing well. She received a 500 c.c. transfusion of whole blood. On April 5 the patient was comfortable and felt much better than previously. The bandage was removed and the incision was painted with flexible collodion. The suture was removed on April 6.

On April 7, the patient was again operated upon. An open reduction of the right condylar fracture had been planned. After the usual preoperative medication and under intravenous pentothal sodium anesthesia, an angulated incision was made in front of the right ear. The subcutaneous tissue was divided. The orbital and transverse facial artery and vein were ligated and cut. The zygomatic arch was located and the glenoid fossa was opened by incision of the capsule of the joint. The condyle was nowhere near the articular fossa, but the meniscus was present. The mandibular fragment could be felt in the lower part of the incision, and finally the condyle was located at the inner surface of the ramus below the mandibular notch. It had attached itself to the bone in this location. After detaching it, it was seen that it had been comminuted, being broken into three pieces. It was felt that there was little hope of getting a good result by retaining the condyle and placing it into position. It was therefore removed, after which the stump of the ramus was made smooth with rongeur forceps and bone files. There was considerable oozing of blood which was stopped with adrenalin packs. Sulfanilamide powder was placed into the cavity, and the subcutaneous tissue was closed with catgut stitches. A small rubber dam drain was inserted to prevent the formation of a hematoma. The skin was closed with a subcuticular suture. Dry sponges and a pressure bandage were applied. Before the patient regained consciousness, she was put in bilateral balanced traction suspension of both legs. Her heart rhythm was grossly irregular and suggestive of fibrillation. Her blood pressure was constant. An electrocardiogram showed paroxysmal auricular tachycardia. Quinidine sulfate, 6 grains, was given.

On April 8 her pulse rate was more regular than before. Swelling was present with slight bleeding and tenderness about the operative wound. The dressing was changed and a borated strip placed on the incision. That night

her temperature spiked to 102° F. Her chest was clear. She was still getting quinidine sulfate, 3 grains three times a day. The heart rhythm was regular on April 9, at a rate of 100. There seemed to be a grade 1 moderately high-pitched diastolic murmur in the third left intercostal space. There were no

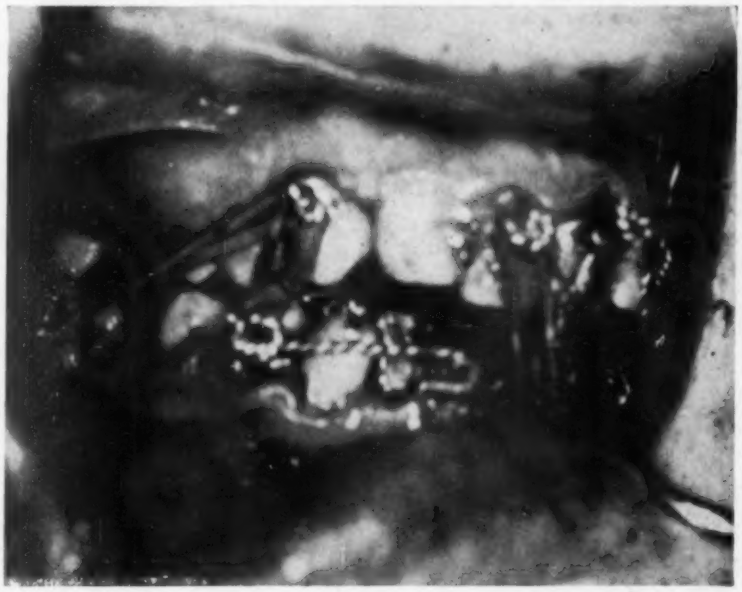


Fig. 265.—Intermaxillary traction applied to Kazanjian buttons to close open-bite.

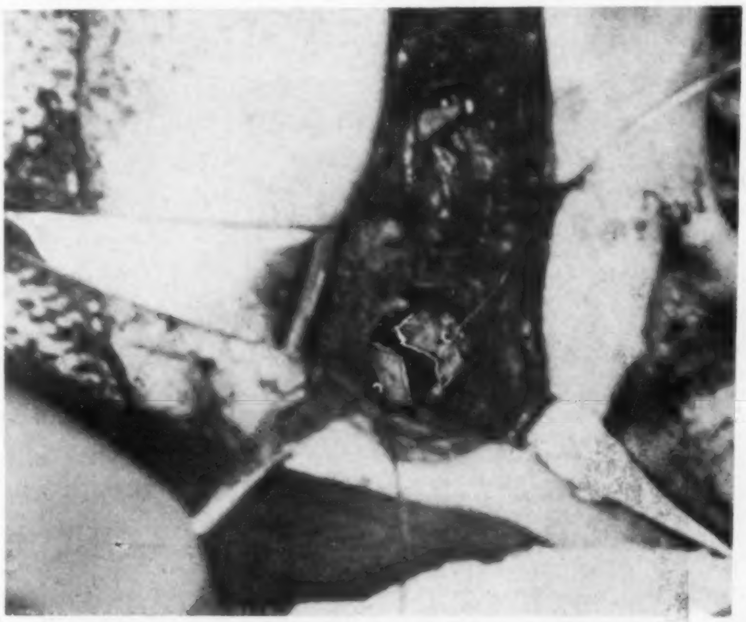


Fig. 266.—Open reduction of condylar fracture on the left. Introduction of wire.

signs of decompensation. The continuance of quinidine sulfate, 3 grains three times a day for a few days, was advised. Swelling was still present at the site of operation, bleeding had stopped, and the patient seemed more comfortable.

Her temperature was 101.8° F., and she had a severe headache. On April 10 her temperature was down a little. She felt much better, and her pulse was regular.

Postoperative x-rays of the jaws were taken on April 10 her temperature was down a little. She felt much better, and her pulse was regular.

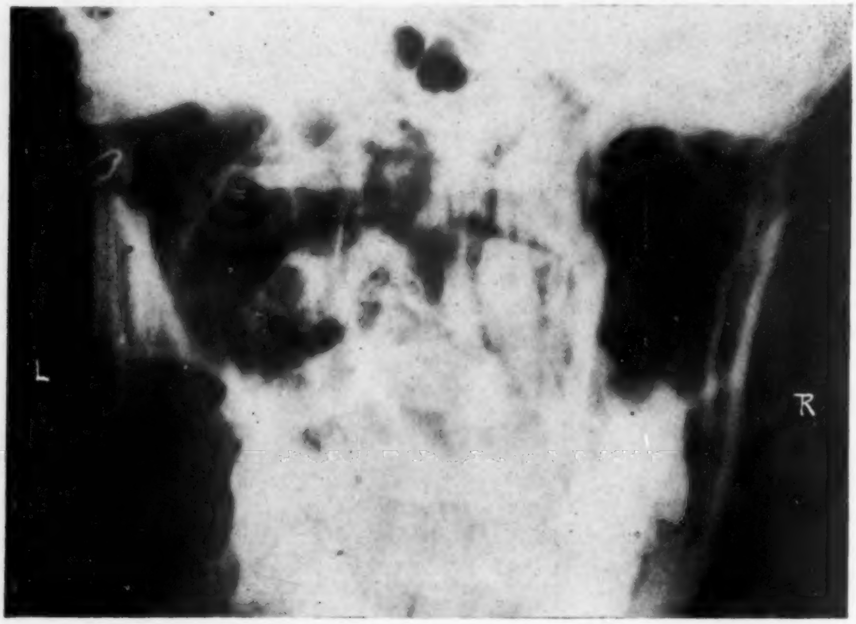


Fig. 267.——Anteroposterior x-ray showing internal wiring fixation on the left, condylectomy on the right.

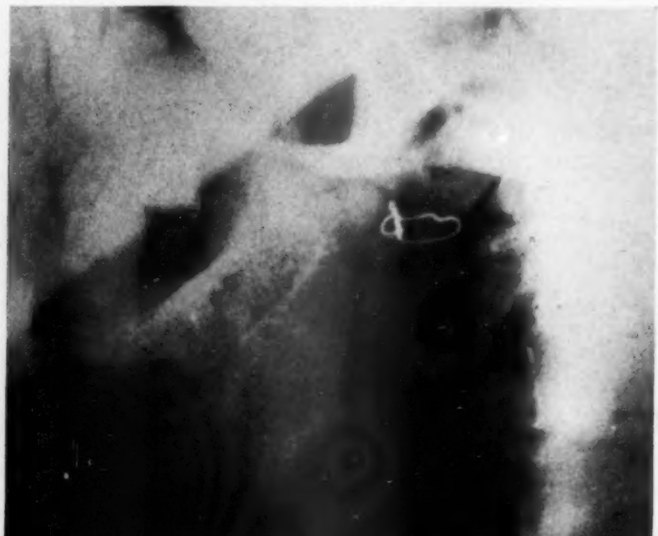


Fig. 268.—Lateral x-ray showing internal wiring fixation.

Postoperative x-rays of the jaws were taken on April 11, and they showed the left condyle to be in good position, the right condyle removed (Figs. 267 and 268).

Quinidine sulfate was discontinued on April 13, and her pulse remained regular at 90. April 16 she looked, sounded, and acted much better. She was exercising her legs in suspension. The suture in the right condylar region was removed on April 18. Slight tenderness was present in this area, though the incision was healing normally. The wires and elastics were removed from her teeth on April 22, and she was advised to exercise her temporomandibular joint, but not to eat hard foods. Mouth hygiene and tooth brushing were encouraged. The function of her facial nerve was tested on May 18, and found to be normal on both sides.

The patient got up on June 2 for the first time. Physiotherapy for rehabilitation was started on June 7. She walked for the first time on June 12 with the aid of a walker and crutches. Her progress was slow, but she was discharged from the hospital on June 30, 1944, with satisfactory results from all procedures.

Case 60

Multiple Comminuted Mandibular Fractures, Including Subcondylar Fracture

R. R. (No. 438182), a 28-year-old man, came to the Emergency Ward on the morning of Feb. 21, 1944. He was referred to the Massachusetts General Hospital from a local hospital. On February 18, he had been in an automobile accident in which he suffered bruises and a fractured jaw.

He presented a tender, and slightly swollen face with a few minor lacerations. X-rays, brought by the patient, revealed a bilateral mandibular fracture which went through the left mandible and through the right condyle.

Examination revealed a poor state of oral hygiene with many badly decayed teeth. The gingival tissues were highly inflamed, and he appeared to have a mild form of Vincent's stomatitis. Movement, crepitus, and pain were experienced upon manipulation of the jaw.

X-ray examination of the jaws on February 21 showed a comminuted fracture of the left mandible in the area of the mental foramen, with the teeth in this area involved and one being displaced (Fig. 270), and also a complete transverse fracture of the base of the neck of the condyle on the right. The condyle itself remained in the temporomandibular joint, but the neck of the condyle was displaced inward (Fig. 272). In the lateral view, there was considerable angulation between the ramus and the fractured condylar process of the jaw (Fig. 276).

On February 24 an open reduction of the compound comminuted fracture of the mandible was performed, using endotracheal nitrous oxide, oxygen, and ether anesthesia. The usual preoperative medication was given. Four half pins were inserted, two on the right side of the chin, and the other two in the middle of the horizontal ramus of the mandible near the inferior border. Next, an intraoral incision was made to locate the displaced tooth, which was found to be a premolar. It was located on the outer aspect of the mandible beneath the periosteum and was removed. Careful inspection of the fracture showed that

Fig. 269.—Frac-Sure appliance used for fixation of comminuted mandibular fracture.

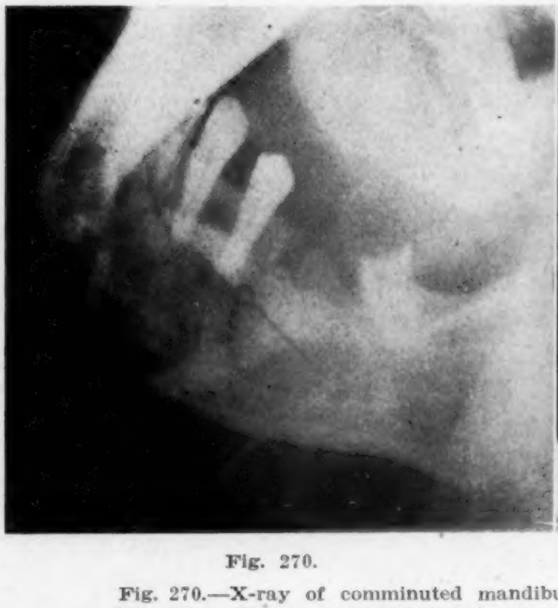


Fig. 270.

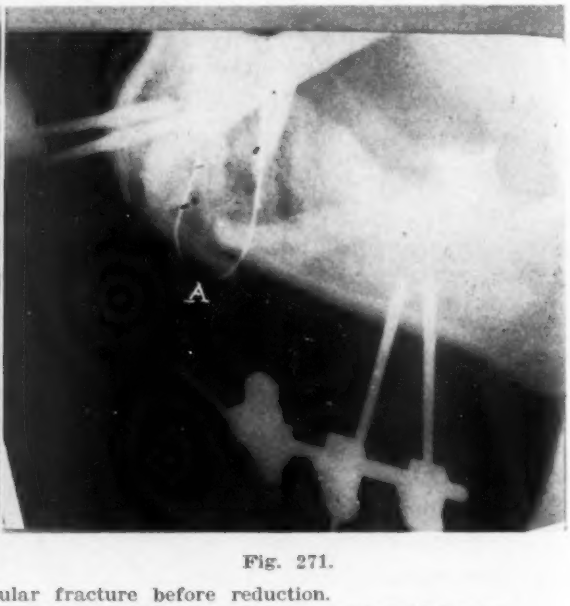
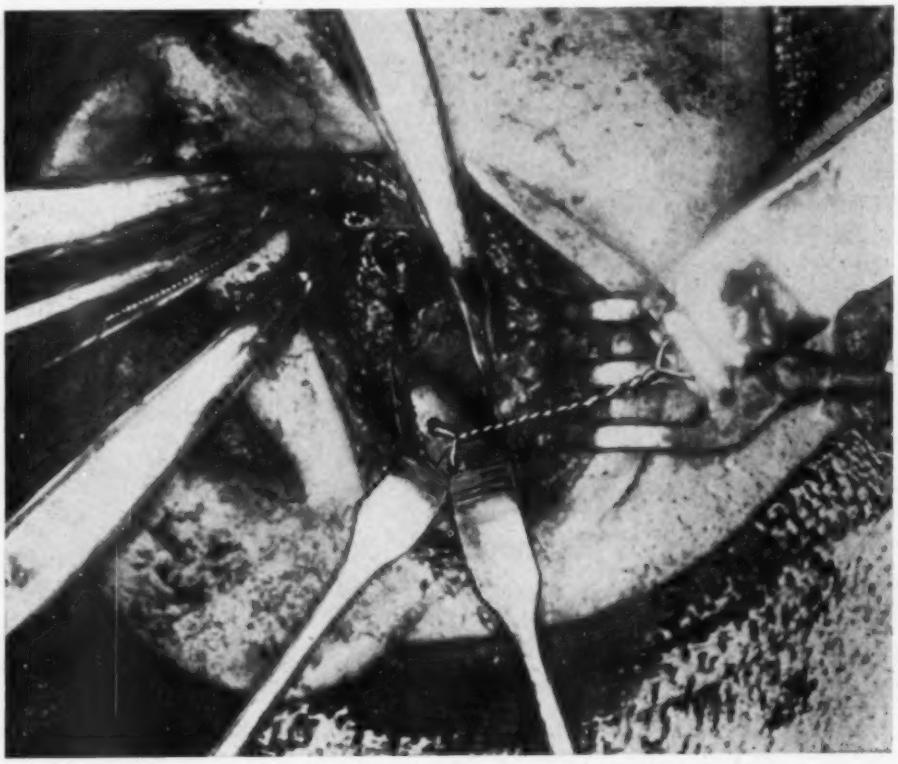


Fig. 271.

Fig. 270.—X-ray of comminuted mandibular fracture before reduction.

Fig. 271.—X-ray of mandibular fracture after reduction showing circumferential wire (*A*) and skeletal fixation.

Fig. 272.—X-ray showing fracture through the neck of the condyle on the right with medial displacement.



B

Fig. 273.—Wire inserted after reduction of the fracture and twisting of the wire with a wire twister (*B*).

there were at least five fragments. It was decided to gather these together by a circumferential wire. An incision was made below the mandible, and a stainless steel wire, 25 gauge, was inserted and tightened over the alveolar process to include all the fragments. The main fracture was thus reduced, after which the cross bars of the Frac-Sure appliance were attached to the half pins and the fracture immobilized (Fig. 269). Postoperative x-rays showed the position and alignment of the fracture to be satisfactory (Fig. 271).

On February 29 an open reduction of the condylar fracture was performed. After the usual preoperative medication, with nitrous oxide, oxygen, and ether anesthesia given through an endotracheal tube inserted through the nose, an angulated vertical incision was made in front of the right ear, extending as far as the attachment of the lobe. The subcutaneous tissue was divided, the orbital and transverse facial arteries and veins ligated and cut. There was considerable bleeding due to edema; several smaller vessels were tied. The neck of the condyle was located and dissected free from the surrounding tissue. It was displaced medially. An assistant then pressed the angle of the jaw upward, and with considerable effort the mandibular fragment was brought into view at the lower edeg of the incision, which could not be extended because of the facial nerve. A hole was drilled from the outer aspect of this fragment into the center of the fracture surface, and into this hole a 25 gauge stainless steel wire was inserted. By means of a bone file the condyle was brought over the mandibular fragment into external displacement, after which a hole was drilled from the outer surface of this piece of bone to the center of its fractured surface. The wire in the mandibular fragment was then drawn through this hole by means of a looped wire passed through the hole to the fracture surface. The fracture was reduced and impacted, when the wire could be twisted for fixation with the wire twisters (Fig. 273). After the wire was cut, it was turned over along the fracture line (Fig. 274). Sulfanilamide powder was inserted into the wound. The subcutaneous tissue was closed with catgut, and the skin with interrupted Kaldermic sutures. A rubber dam drain was inserted into the fracture area between two of the stitches to take care of bleeding (Fig. 275). A pressure bandage was applied to the side of the face.

Postreduction x-rays showed the condylar fragment to be in good position when viewed from an anteroposterior projection (Fig. 278). In the lateral projection there seemed to be some angulation of the fragments (Fig. 277). This, however, was due to the fact that the x-ray was taken before the jaw was immobilized with the teeth in occlusion.

Sulfadiazine therapy was continued until the patient's discharge from the hospital. On March 6 the sulfadiazine level of the blood was 5.4 mg. per cent. On March 2 there was a discharge from the inferior border of the mandible at the site of the comminuted fracture. A bacteriologic culture on the same day, made from this discharge, showed the presence of moderate *Staphylococcus aureus,* and nonhemolytic streptococcus. The right cheek was somewhat swollen. An intraoral splint was constructed and placed into the mouth, and a Barton bandage with rubber band traction applied. The splint brought the teeth into good occlusion. The immobilization of the mandible used to supplement the fixa-

Fig. 274.—Wire cut and bent around the neck of the condyle.

Fig. 275.—Incision closed by interrupted sutures. Note the rubber dam drain to take care of bleeding.

tion of the condylar fracture had a beneficial effect on the infection; the discharge decreased noticeably. The splint and the circumferential wire were removed on March 16, twenty days after they were inserted, and the patient was sent home, to be followed in the Outpatient Department. He was given instruction in

Fig. 276.

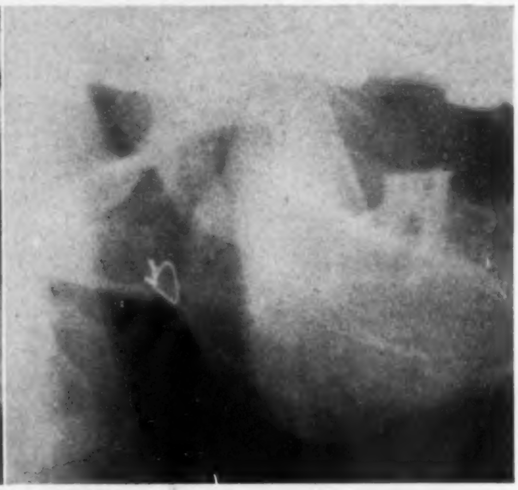


Fig. 277.

Fig. 276.—Lateral jaw before reduction.
Fig. 277.—Lateral jaw after internal wiring fixation with mouth open.

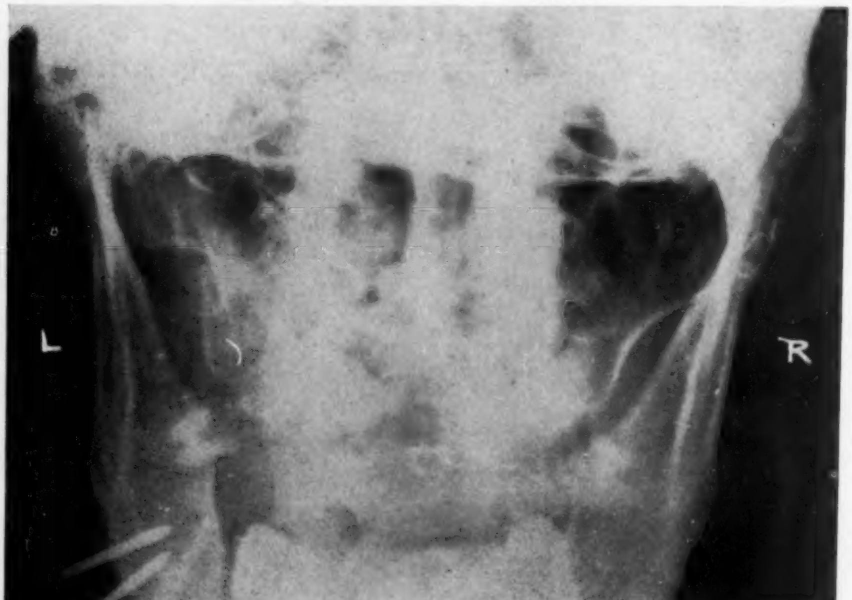


Fig. 278.—Anteroposterior x-ray showing reduction of fracture and internal wiring fixation.

home care and oral hygiene. The half pins used for skeletal fixation were removed in the Outpatient Department on March 29. X-rays taken at this time showed some resorption anterior to the fracture line, and there appeared to be numerous areas of rarefaction consistent with osteomyelitis. The position of the fragments, however, appeared to be good. Clinically, the fractured bone was

firm, and there was no evidence of infection. The patient had satisfactory function of the jaw; both hinge and lateral motion were good. He had some paresis of the right eye due to injury of the zygomatic branch of the facial nerve. When seen again on April 26, this condition had considerably improved. The patient was discharged permanently on April 26.

Case 61

Multiple Mandibular Fractures Including Subcondylar Fractures

P. B. (No. 435576), a 17-year-old boy, was brought to the Emergency Ward on Feb. 4, 1944, suffering from facial lacerations, multiple fractures, and early traumatic shock.

The night before, he had suffered a severe automobile accident in which a sailor companion was killed. Details of the accident were not known. He was taken to a local hospital where two compound fractures of the right leg, comminuted skull fracture, and multiple abrasions were found. He was then brought to this hospital, where he was found to be responsive to direct commands and to his name, but unable to converse.

On examination, his skin was moist and cool. His head was bandaged above the level of the mouth, his right leg was in a Thomas splint, and there were multiple abrasions about his head, mouth, and upper body. The heart rate was rapid and strong; there was a sinus arrhythmia, and a grade 2 systolic murmur. His blood pressure varied from 90/60 to 110/70. The rest of the physical examination was negative.

X-rays showed fracture of the mandible. There were also transverse fractures through the middle of the tibia and fibula with 2.5 cm. overriding.

He was given two units of plasma, a blood transfusion, and intravenous sodium sulfadiazine, then taken to the operating room where, under spinal anesthesia, an open reduction and bone plating of his fractured tibia was carried out. He was transferred to the neurosurgical service because of his head injuries. Also, on February 4, under endotracheal nitrous oxide, oxygen, and ether anesthesia, débridement and suture of the lacerated scalp was carried out (Fig. 279). There was no evidence of any fracture of the skull in the anterior half, nor in the region of the frontal sinuses. The patient withstood the procedure well. Temporary reduction of the mandibular fracture by means of horizontal wiring was carried out later when the patient was returned to his room.

X-rays of the jaw taken on February 5 showed fractures of the necks of both mandibular condyles with considerable displacement of the fragments (Fig. 282). There was also a fracture of the anterior portion of the horizontal ramus of the mandible on the right. These fragments were held in fairly good position by the temporary wires.

On February 8, when the sulfadiazine level in the blood was 8.7 mg. per cent, external fixation of the fractured jaw was carried out with the usual preoperative medication and local anesthesia. A double mandibular block was made and the subcutaneous tissue on the outer surface of the mandible was infiltrated.

Fig. 279.—Patient with multiple mandibular fractures and face lacerations sutured.

Fig. 280.—Temporary fixation of mandibular fractures with Frac-Sure appliance.

Two pins were then inserted into each fragment lateral to the chin, and crossbars of the Frac-Sure appliance attached to them. The incisions were painted with collodion. The wires previously applied for temporary intraoral reduction were then removed. The left first mandibular incisor was extracted because it extended into the fracture line. The fractures were reduced by direct manipulation, after which a connecting bar was passed through the two connecting links to complete the previously described appliance (Fig. 280). A dressing was applied around the pins.

Jelenko splints were next applied to both the upper and lower dental arches by means of stainless steel wire passed around the teeth. Strong intermaxillary elastics were attached to the lugs on these splints in such a manner that the mandible was pulled forward (Fig. 281). It was hoped that normal occlusion would be established by this method within forty-eight hours, when the bilateral fractures of the mandibular condyles, especially the dislocation fractures, could be reduced.

Fig. 281.—Elastic traction applied to close open-bite.

Postoperatively, his general condition was very good. On February 9 his occlusion was slowly being established. By February 11 the occlusion was about normal. X-rays showed that the fracture through the central portion of the mandible was in good position. The patient complained of a toothache on February 12. Since interference with the rubber band traction was not advisable at that time, he was given codeine and aspirin for pain, and it was planned to take care of the tooth just before permanent intermaxillary ligation was instituted in conjunction with the reduction of the condylar fractures. The sulfadiazine level at this time was 7.8 mg. per cent.

The second operation was performed on February 15. The plan was to reduce the fracture dislocation on the left and fix it by means of the Frac-Sure appliance, as shown in Fig. 283, hoping that with the occlusion re-established the right condylar fracture would be in sufficiently good position to take care of itself. After the usual preoperative medication, endotracheal nitrous oxide oxygen, and ether anesthesia was induced for open reduction of the fracture dislocation of the left condyle. A vertical angulated incision was made in front of the left ear. The superficial orbital artery and vein were divided and tied, after which the subcutaneous tissue was incised and the zygomatic arch exposed in the region of the mandibular joint. Dissecting in the anterior direction, the eminentia articularis was also exposed by detaching the posterior end of the masseter muscle. The transverse facial artery was then divided and tied, after which the condyle was located, deep in the wound, and elevated into the field of

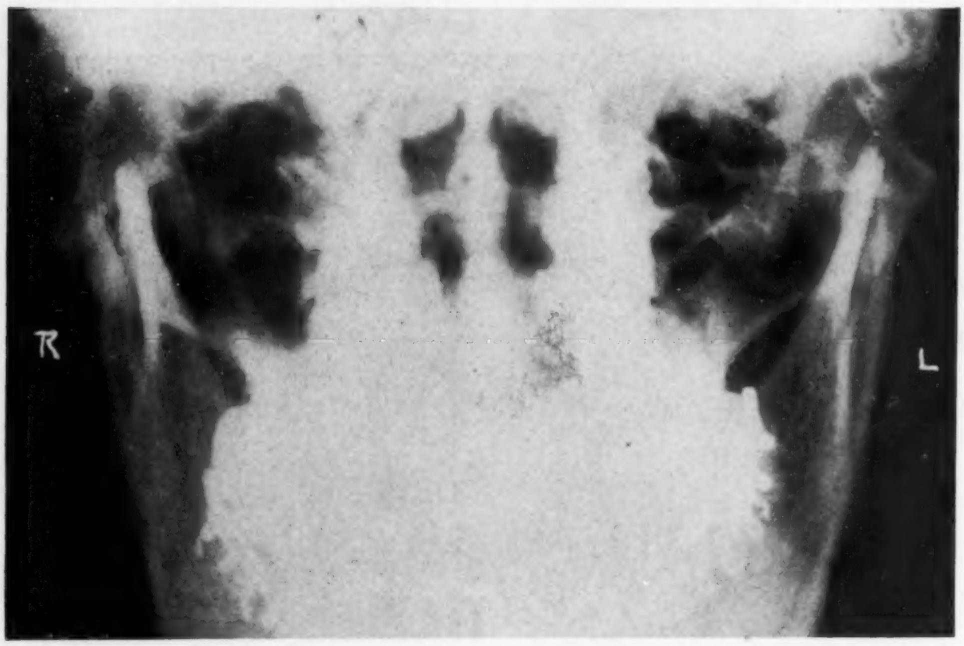


Fig. 282.—Bilateral fracture of the condyles with medial dislocation.

operation. It was held with bone forceps in order to drill a hole just at the junction of the condylar head and neck. A half pin was then inserted into this hole. Another hole was drilled into the eminentia articularis. The drill was directed in a posterior and superior direction, and here a half pin was inserted through a stab incision in the skin, under direct vision. Both pins were tested and found firmly embedded. The dislocation was then reduced by placing the condyle into the glenoid fossa and impacting it against the mandibular fragment, after which a crossbar was applied to the pins with Frac-Sure links, and made fast. It was not possible to expose the mandibular fragment, because the facial nerve prevented the incision from being carried further down, and wiring of the fracture, therefore, was not attempted. After placing

sulfanilamide powder into the wound, the capsule of the joint was sutured with chromic catgut. Next, the subcutaneous tissue was sutured, and finally the skin was closed by a subcuticular suture, allowing the pin in the condyle to protrude through a small vertical extension from the first incision (Fig. 284). Tincture of benzoin was placed on the wound and around the pins, and a pressure bandage applied.

The Jelenko arches, which had become loose on the right side, were reattached to the teeth, after which a small wedge was placed between the molars on each side. Elastics were applied to cause traction in an anterior direction and to close the open-bite in the incisor region for the purpose of overcoming, if possible, any overriding at the condylar fracture on the right (Fig. 281).

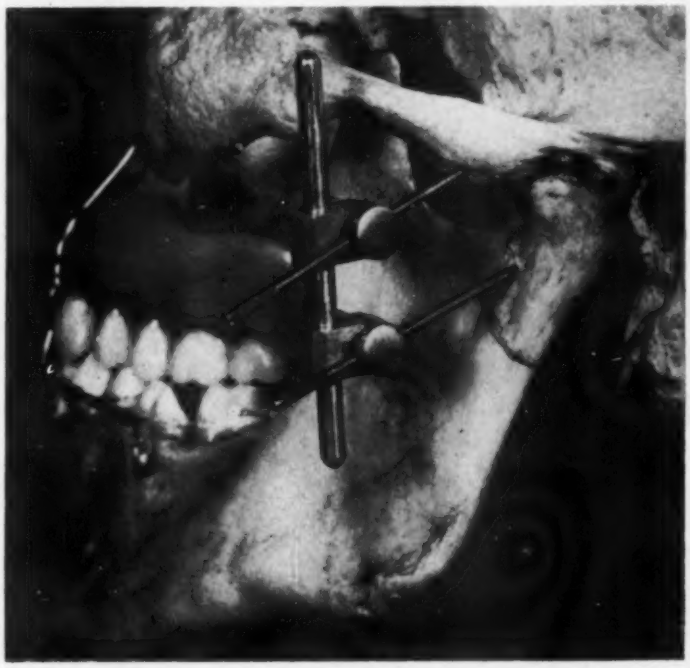


Fig. 283.—Skull illustrating fixation of fracture dislocation by one pin inserted in the eminentia articularis, a second pin into the condyle.

Postoperative recovery was good, and on February 19 he was discharged with instructions for strict home care, to be followed in the Outpatient Department. On February 25 he appeared comfortable but uncooperative. He had removed the anterior rubber bands. However, x-rays showed no apparent change in positioning of the fractures. The rubber band traction was reapplied, and the dressing changed around the pins. He was given strict instructions to leave the appliances alone. The two half pins in the condyle and eminentia articularis were removed on March 8. There was a slight amount of stringy seepage from the perforations in the skin after the pins were removed. The pin holes, therefore, were irrigated with zephiran. By March 15 the mandibular fracture was tested after loosening the nuts of the Frac-Sure appliance. It seemed to be firm so that the skeletal fixation could be removed also. The pin

holes were treated with zephiran. The occlusion was not as good as expected, because the patient removed the rubber bands while under treatment.

His teeth were ground on March 29, and the upper and lower left premolar extracted with local anesthesia to improve the occlusion and to close the

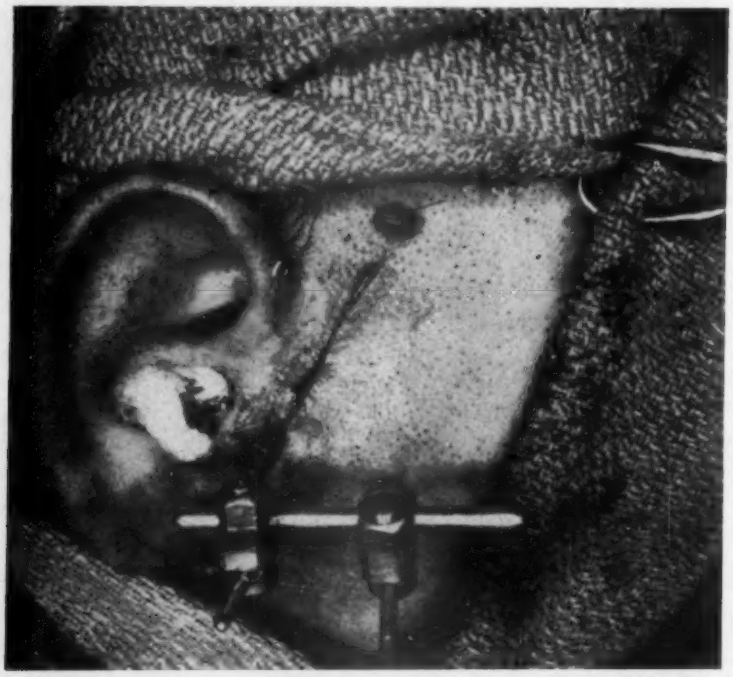


Fig. 284.—Patient with two pins inserted and the condyle immobilized with Frac-Süre appliance.

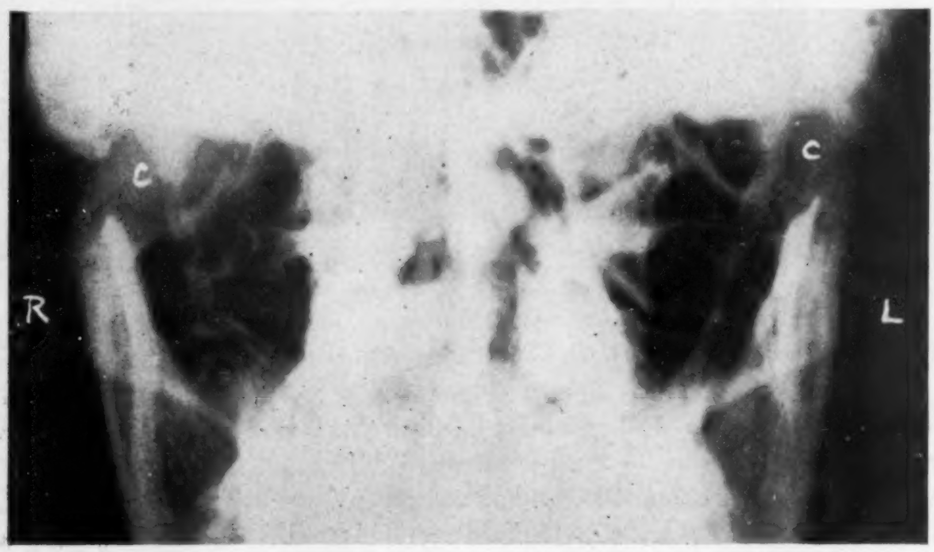


Fig. 285.—Postreduction x-ray showing on the right an unreduced dislocation; on the left a reduced dislocation of the condyles (*C*).

bite. The patient said, when he was seen on May 19, that two small pieces of bone had been discharged from the right mandible, but there was no evidence of swelling or osteomyelitis. He was permanently discharged on May 24, after follow-up x-rays were taken. These showed good position of the condyle on the

left which was reduced by open operation, while on the right, which was not treated, the fracture had healed also but the condyle had remained in dislocated position (Fig. 285).

Case 62

Mandibular Fracture With Osteomyelitis

J. W. (No. 440883), a 67-year-old man, was admitted to the hospital on March 11, 1944, with a diagnosis of a fractured right mandible complicated by osteomyelitis.

Nine weeks before admission, this man stubbed his toe, fell, and hit his chin on a curbstone. In this manner the mandible was fractured and a tooth knocked out. His jaw had been immobilized with an intraoral mandibular splint and a Winter appliance on the maxillary teeth, combined with intermaxillary ligation.

On examination of the patient, a somewhat tender swelling was found at the angle of the jaw on the right, with a fistula discharging pus. The occlusion was apparently good. Physical examination of the patient showed him to be in good general health.

Fig. 286.—Fracture previously treated with a splint depressing the molar in the posterior fragment with osteomyelitis.

X-ray examination showed an ununited fracture with osteomyelitis in the fracture line and a large sequestrum; attached to this was the second molar, which apparently had been retained to control the posterior fragment by means of a wire extending from the splint (Fig. 286).

Sulfadiazine therapy was instituted; 2 Gm. were given to start, then 1 Gm. every four hours and 1 dram of sodium citrate with each dose. He was also started on vitamin therapy consisting of vitamin B complex, vitamin C, and vitamin ABD capsules.

A sequestrectomy was performed on March 13, using intravenous pentothal sodium anesthesia with the usual preoperative medication. An incision

was made about 1 cm. below the angle of the jaw. A hemostat was inserted, and some seropurulent discharge evacuated. This was cultured. The dissection was continued until the bone came into view. A loose sequestrum was encountered but it could not be drawn down. The mouth was then opened after removing the wires, and the mandibular splint was removed. The involved right lower molar was extracted, after which a hemostat was inserted with which the sequestrum could again be felt. It was necessary to break it in order to remove one piece from the mouth and another from the external incision. A rubber dam drain was placed into the abscess cavity, and sutured to the skin with two silk sutures. Dry dressings were applied, and the patient returned to his room in good condition.

The culture taken on March 13 was reported to contain alpha hemolytic streptococcus, 3 plus sensitive to penicillin. The pathologic specimen presented a gross appearance of three irregular fragments of bone to which were attached a few small pieces of soft tissue. The pathologic diagnosis was chronic inflammation with osteomyelitis.

After the operation the patient was comfortable, and the wound drained well. The swelling seemed to increase some in size. The white blood count on March 15 was 8,200. On March 16, the swelling appeared to be hard around the incision. The sulfadiazine level in the blood was 8 mg. per cent on March 17. By the next day the swelling had increased in size but still was hard; however, no discharge was present. He had no pain or inflammatory sensations in the area.

X-rays of the jaw showed a small sequestrum measuring 1.7 by 0.4 cm. remaining between the fragments at the level of the roots of the adjacent first molar. The position of the fragments was good except for some separation.

A second operation was performed on March 20, again under intravenous pentothal sodium anesthesia, for fixation of the fracture by means of a Frac-Sure appliance. After the usual preparation, small stab incisions were made in the skin in the anterior fragment. Holes were drilled near the inferior border, and half pins firmly inserted. In the posterior fragment the skin incision was made over the posterior border of the ramus. The subcutaneous tissue was opened by blunt dissection down and through the periosteum. A hole was drilled through the outer, but not quite through the inner cortex, and a half pin was firmly inserted. After this, a second incision was made over the angle of the jaw, and without using a drill, a pin was inserted in an oblique upward direction. This pin also was very firm. Since the x-ray showed a small sequestrum left in the center of the fracture line, this was removed by enlarging the incision. The fracture was then reduced and the fragments impacted as well as possible. The cross links and connecting bars were attached to the pins, and fixation completed. Collodion was applied around the pins, and a small sponge was wound around each pair of pins as a dressing (Fig. 287). A rubber dam drain was inserted into the incision and sutured to the skin, after which a dry dressing was applied and held down with a piece of tape.

Postreduction films showed some narrowing of the fracture line. The fragments were in direct contact at the lower border of the jaw. The sequestrum could no longer be seen.

The immediate postoperative course was uneventful. There was no bleeding and little swelling of the jaw. Intraoral wire buttons were applied to the lower teeth to attach intermaxillary elastics to immobilize the mandible. He received a transfusion of 500 c.c. whole blood on March 23. Because he was comfortable the following day and the swelling had practically disappeared, the rubber dam drain and the two six sutures attaching it were removed. However, his face swelled again on March 24, and there was some pus discharge through the incision and adjoining pin holes. The culture report from this discharge revealed the presence of alpha hemolytic streptococcus and coagulum positive *Staphylococcus aureus*. The staphylococcus strain was penicillin sensitive. On March 29 sulfadiazine therapy was discontinued and penicillin therapy was instituted instead. He was given 2 c.c. of a solution containing 5,000 units in each cubic centimeter, intramuscularly, every four hours. In addition, penicillin, 500 units per cubic centimeter, was injected into the incision. On March 30 and 31, there was very little discharge found, not enough for a culture on either day.

Fig. 287.—After sequestrectomy the fracture is reduced and a Frac-Sure appliance inserted.

On April 4 when the penicillin therapy was discontinued, a total of 490,000 units having been administered, there was only a small indurated swelling left with slight tenderness in the region of the pins in the anterior fragment. There seemed to be some callus formation in the line of fracture at the inferior border. The white blood count was 8,000. He was given a transfusion of 500 c.c. whole blood on April 5, and two days later he was discharged from the hospital.

On May 1, an x-ray was taken which showed some callus between the fragments, and some bone resorption around the pins in the ramus. The Frac-Sure appliance was removed, and it was found that there was good union of the fragments. The patient was kept under observation for two more weeks, when he was discharged completely relieved, except for some malocclusion resulting from the shortening of the jaw brought about by the loss of bone in the fractured

area. Since all his upper teeth were bad, extraction was thought to remedy this condition. He was referred to his dentist to have the teeth extracted and replaced by a denture that will occlude properly with the mandibular teeth.

IV. ANKYLOSIS AND FALSE ANKYLOSIS

False ankylosis is generally temporary in nature due to inflammatory trismus of the masseter or internal pterygoid muscles. However, we have seen two patients in the clinic, one with ankylosis of five and one-half months, and the other of three weeks' duration. Both followed multiple injections for mandibular nerve block with a local anesthetic.

We have also seen a case of false ankylosis of an entirely different nature. It was caused by a fibrous adhesion connecting the upper to the lower jaw, which prevented opening the mouth (Fig. 288).

Fig. 288.—False ankylosis due to adhesion between upper and lower jaw.

In true ankylosis the mobility of the jaw is decreased or absent because of fibrous or bony union occurring between the condyle and the glenoid fossa. The condition may be of traumatic origin, birth trauma from injury by means of the forceps used in head presentations being a recognized type, and intracapsular fracture. A case (No. 46) reported in *Volume II* is a typical example of ankylosis due to birth trauma. Case 12, described in *Volume I,* presented an ankylosis and pseudoarthrosis in the site of the fractured condylar neck. Infectious arthritis is another cause; Case 13 in *Volume I* was due to infectious arthritis contracted when the patient was 56 years of age. A patient was also seen with bilateral ankylosis due to Marie-Strümpell disease. A good result was obtained by bilateral osteoarthrotomy, though the operation was made difficult because of the rigidity of the patient's spine. In this volume another patient

is reported on who had an ankylosis caused by arthritis. In Case 13 a good result was obtained, probably because the onset of the disease was at the age of 56 when the mandible and its musculature had fully developed, while in the patient reported here, the elevator muscles were underdeveloped and, therefore, resisted opening the jaw after it had been mobilized by the operation.

Case 63

Ankylosis of the Mandibular Joint

M. C. (No. 440528), a 31-year-old woman, presented herself at the Outpatient Department on March 8, 1944, complaining of inability to open her jaw.

The trouble started when she had rheumatic fever at the age of 2 years. The disease affected many of her joints, and an abscess formed in the back of her neck which was incised and drained. Since then her jaw had been fixed. She had leverage treatment for her jaws when 8 years old, but was discharged by her dentist, unimproved. Four or five years ago, her mandible started to develop in an anterior direction, with the result that the mandibular incisors were occluded with the maxillary teeth in an "edge-to-edge" bite. She was bothered with toothaches. An anterior tooth was abscessed and caused a periodic flare-up. Since her teeth could not be taken care of with her jaw locked, she decided to have her jaw condition remedied.

Fig. 289.—Profile of patient with ankylosis of the jaw.

On examination it was found that her chin was markedly receded with the mental apex to the left of the midline, indicating that the left joint was the one principally affected (Fig. 289). She had about ½ cm. of vertical movement in her mandible, but no lateral motion (Fig. 290).

X-rays of the jaws showed considerable asymmetry of the mandible with rather marked thickening of the neck of the condyle and ascending ramus on the left side. There appeared to be fusion of the left temporomandibular joint. The joint space was somewhat narrowed. The head of the condyle appeared to be in normal position, but markedly enlarged (Fig. 291). In a lateral view the mandible appeared shortened on the left. The third molars on either side of the lower jaw were unerupted and impacted. The left ascending ramus culminated in a narrow coronoid process and a broad condyloid process, the head of which was apparently fused to the skull over a wide area reaching all the way to the poorly developed articular eminence (Fig. 292).

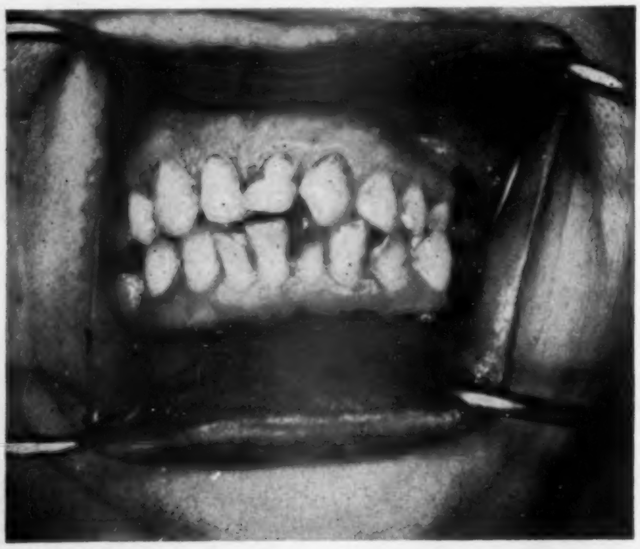


Fig. 290.—Photograph of maximum distance the patient could open her jaw.

She was admitted to the House on April 24, for an osteoarthrotomy to be performed on April 26. After the usual preoperative medication, and under endotracheal nitrous oxide, oxygen, and ether anesthesia administered through the nose, the skin was prepared in front and above the left ear in the usual manner. An angulated vertical incision was made in front of the ear, extending as far as the attachment of the lobe. The subcutaneous tissue was divided, and the superficial orbital artery and vein tied and cut. The zygomatic arch was dissected down upon and the periosteum incised and stripped from the bone. The periosteal incision was extended down over the mandibular condyle, which was found to be at least twice its normal size, and completely ankylosed to the zygomatic ach. Some difficulty was encountered in dissecting downward on the neck of the condyle because of the proximity of the facial nerve. The tissue here was tested, and a reflex of the eye noticed. The zygomatic branch of the facial nerve was demonstrated and preserved. An osteotomy, by means of burrs and osteotomes, was performed as low down on the neck of the condyle as retraction of the facial nerve would permit. After the ramus was completely severed, part of the zygomatic arch was removed and the ankylosed joint surface exposed. There was no possibility of cleavage, so that the condyle had to

be cut away from the base of the skull by means of an osteotome and with back-biting forceps. About half an inch of space was gained between the base of the skull and the amputated surface of the ramus (Fig. 295). The latter was smoothed by means of bone files. Some of the muscular bleeding was stopped

Fig. 291.—Anteroposterior view showing enlarged ankylosed condyle on the left.

Fig. 292.—Lateral jaw showing narrow coronoid process and very large condyle ankylosed to the base of the skull.

by inserting fibrin foam, soaked in thrombin, into the bottom of the cavity ensuing from the removal of the condylar fragment. Sulfanilamide powder also was inserted, after which the subcutaneous tissues were closed with catgut sutures and the skin with a subcuticular suture. Compound tincture of benzoin, and several pieces of gauze with a pressure bandage, were applied. (Fig. 296.)

After this the drapings were removed so as to get access to the patient's jaw and mouth. There was a great deal of resistance to opening the jaw, in spite of the fact that at the operation it was noticed that the left ramus was freely movable. It was thought that this might either be due to atrophy of the muscle

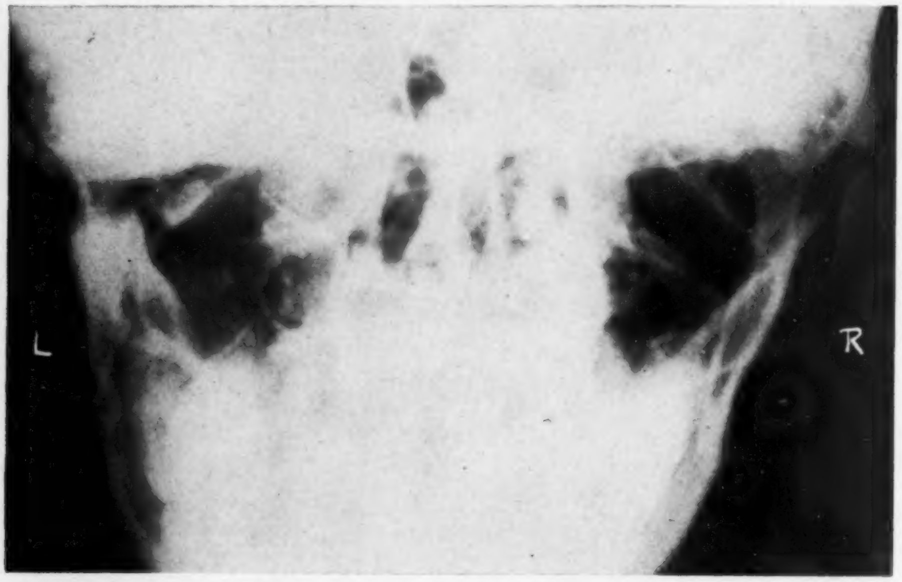


Fig. 293.—Anteroposterior view showing condylectomy on the left.

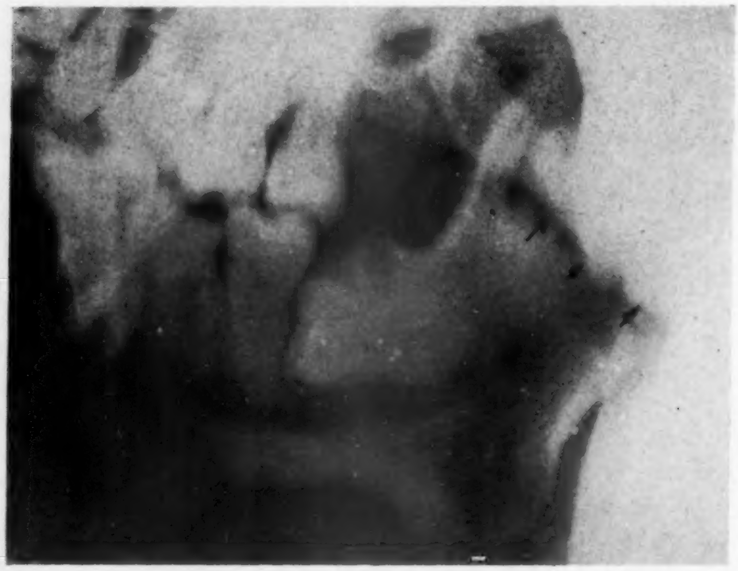


Fig. 294.—Lateral x-ray after condylectomy. Note the surface where osteotomy was performed (arrows).

on the side appearing normal in the x-ray examination, or that some form of ankylosis was present on the other side. The mouth was opened about 1 inch between the incisor teeth by means of a screw gag, and a wooden wedge was placed between the teeth on the right side to hold the jaw in this position (Fig. 297).

Fig. 295.—Photograph of incision and space (*S*) produced by excision of the condyle.

Fig. 296.—Incision closed by subcuticular suture.

The occlusal block was removed the next day. Three days later the patient could open her mouth about ¾ inch. She was comfortable, but there was some swelling over the left temporomandibular joint. The sutures were removed on April 30, and she was discharged to be followed in the Outpatient Department after an uneventful hospital course. She was advised to use exercises to increase the mobility of the mandible.

X-rays taken after the operation show, in anteroposterior projection, the condyle amputated with the coronoid process still present (Fig. 293), and, in lateral projection, the great width of the amputation surface (Fig. 294).

Fig. 297.—Patient after the operation with wedge between the teeth.

When she was seen on May 27, a slight amount of paresis of the left eyelid was noticed. This apparently was caused when the nerve was stretched by the retractor, and was expected to disappear in time. Her jaw moved freely, but she could open her mouth only about ¾inch. She was advised to continue with her exercises, particularly with the "lamp shade" exerciser (a lamp-shade holder with two loops that fit over the light bulb), and to return to the Dental Clinic in two months. On July 26 she was examined again; her neurological defects had improved so that she could close her left eye. There was very free motion of the jaw, but it came to a solid stop, which seemed to be either due to underdevelopment of the elevator muscles, or to a fibrous band extending from the posterior part of the maxilla to the posterior part of the mandible. This band could be seen, but as she could not open her mouth sufficiently, it could not be palpated easily. The patient was advised to have another House admission to have these adhesions severed and the muscles dilated. She was in very much better health since she had been able to eat properly, and had gained 11 pounds.

Discussion.—The deviation of this patient's chin indicates that she had a unilateral ankylosis. According to Rushton (1944),* ankylosis affects the epiphyseal growth of the condyle, and with it, the length of the involved side of the mandible. It should be of interest to know whether an operation during childhood would prevent underdevelopment or whether it would increase it. If the mandible depends principally on the condylar epiphysis for its growth, as Rushton claims, condylectomy would produce more marked underdevelopment than does ankylosis. If, on the other hand, interstitial growth stimulated by muscular activity associated with mastication is the main factor in jaw development, then it could be expected that the mobilization of the jaw by an operation in early life would allow the mandible to develop normally. Recently we have seen a patient, 18 years of age, who had a condylectomy performed at the age of 10 years. She had as much asymmetry of the face as the patient reported here, but not as much as the patient with ankylosis from birth trauma reported in the previous volume, Case 46. From this we may deduct that in the absence of the condyle the re-established mobility during childhood will mitigate the deformity, and that development of the mandible depends both on epiphyseal growth and interstitial growth, probably more on the former than on the latter. Otherwise, the side with the normal epiphysis would not develop to the extent that it does.

While underdevelopment of the mandible in cases of early ankylosis causes deforming micrognathia and asymmetry of the face associated with underdevelopment of the temporal, masseter, and internal pterygoid muscles, it also gives rise to functional debility which must always be reckoned with in these cases, and which requires prolonged self-treatment, as in the case described.

V. BLOOD DYSCRASIAS

Two cases with blood dyscrasias are reported in this issue: a case of lead poisoning with stipple cell anemia and characteristic lead seam, and a case of erythroblastic anemia. The latter is a familial anemia which is of interest to us because of its effect on the skeleton, and is also known as Cooley's anemia or Mediterranean disease. Vogt and Diamond (1930)† have reported on the roentgen findings of this disease. A case was also described by Novak (1944).‡ The patient seen by us presented marked changes in the anatomic and histologic make-up of the jaws.

Case 64

Lead Poisoning With Stipple Cell Anemia

L. P. (No. 441426), a 33-year-old male, was admitted on March 18, 1944, for the purpose of study. He complained of upper abdominal pain, vomiting, constipation, and slight elevation of temperature on three occasions during the past year.

*Rushton, M. A.: Growth at the Mandibular Condyle in Relation to Some Deformities, Brit. D. J. 76: 57, 1944.

†Vogt, E. C., and Diamond, L. K.: Congenital Anemias, Roentgenologically Considered, Am. J. Roentgenol. 23: 625, 1930.

‡Novak, A. J.: The Oral Manifestations of Erythroblastic (Cooley's) Anemia, Am. J. Orthodontics and Oral Surg. (Oral Surg. Section) 30: 539, 1944.

For many years the patient had felt emotionally labile, extremely tired and sleepy, and had had backache, headache, and pains in his upper eyelids. He had also had severe aches and pains in his legs. Eighteen months previous to admission, the patient noticed that his gums had become pink, swollen, and tender, with hemorrhage. He went to his dentist, who gave him no satisfactory explanation of the condition. About thirteen months previous to admission, the leg aches and pains became more severe and spread to the hips and lumbar areas. In April, 1943, he had the first of a series of four spells consisting of pain in the upper abdomen, mainly in the epigastrium, with no relation to meals; it was a steady pain, but with exacerbations in a cramplike fashion accompanied by a sensation of a ball-like structure in the epigastrium. The patient vomited several times during these attacks, and there was a slight rise in temperature. During the first spell, he was told that he was mildly jaundiced. He became severely constipated. The first attack lasted three weeks. The patient was investigated at a local hospital, and in May, 1943, his gall bladder and appendix were removed. No pathologic report was available. He improved and went back to work. Four months later he had a similar attack, also lasting about three weeks, but no jaundice was noted at this time. A third attack followed in February, 1944, with marked increase in the severity of the pain. During the past year the patient stated that he had lost 20 pounds.

Fig. 298.—Patient showing lead line.

The patient's occupational history was significant; he had been a spray-painter of trucks for more than a year in a closed shed with inadequate ventilation, and he had also done considerable work on battery plates.

Physical examination showed the patient to be well developed and well nourished. A well-defined metal line was seen about the gingival margin of the teeth (Fig. 298). He had a slight tremor of his fingers, increased on motion.

The laboratory findings showed normal urine; white blood cell count, 12,900; red blood cell count, 3.7; hemoglobin, 10 Gm. with 56 per cent polymorphonuclear leucocytes, 34 per cent lymphocytes, 5 per cent monocytes, and 5 per cent eosinophiles. A smear showed definite hypochromia with 0.4 per cent stipple cells (Fig. 299). The stool was guaiac negative. Nonprotein nitrogen 35; total protein 7.2; albumin-globulin ratio 2:8. A gastrointestinal series showed the upper gastrointestinal tract to be normal in form and function. The Hinton and Wassermann were negative. The basal metabolic rate was -14.

A blood sample, taken by the laboratory of the State Department of Occupational Hygiene, showed 0.11 mg. of lead per 100 millimeters. Urine showed 0.05 mg. of lead per liter of urine.

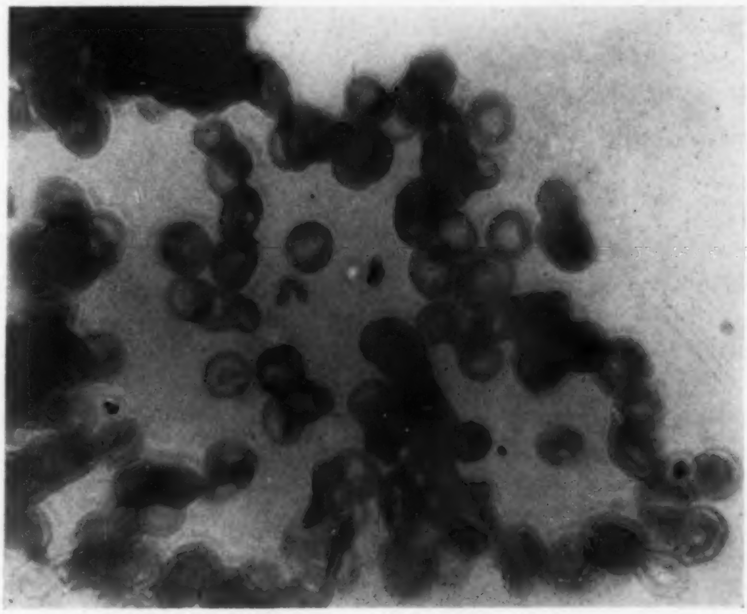


Fig. 299.—Blood smear showing stipple cells.

The patient was also seen by the psychiatric consultant who stated that he had had an anxiety neurosis for years, and now has lead poisoning superimposed with anemia and possible brain changes, which might explain the marked emotional lability and fatigue.

The patient was treated with a deleading diet and iron, and was discharged improved.

Case 65

Erythroblastic Anemia

S. T. (No. 453690), a 16-year-old Italian boy, was referred to us because of a peculiar swelling of the upper jaw, and three infected carious teeth which needed to be extracted.

The mother of the boy stated that his father had high cheekbones and a thickened middle face with a small nose, but not the extreme condition pre-

sented by this patient. The father's native country is Italy and he does not know if any other members of his family are so afflicted. The parents noticed that the patient had an abnormal face development soon after birth. He was always a rather delicate child, subject to colds and malaise, and his mother was very anxious about him.

He had been seen at the Children's Hospital, and was later referred to the Peter Bent Brigham Hospital a few months ago when he sustained an incomplete fracture of the forearm. This healed in approximately eight weeks. At the Brigham Hospital, to which we are indebted for the following information, he was sent to the medical ward because of a high fever. His temperature was 105.6° F. by rectum, pulse rate 132, respirations 32, and blood pressure 120/66. He was found to have a bilateral nasal obstruction, his throat was somewhat inflamed and the tonsils enlarged, and there was moderate submaxillary lymphadenopathy. His chest was remarkably clear. His heart was hyperactive, not enlarged to percussion, with a forceful apical impulse without thrills. There was a grade 2 apical systolic murmur. The P_2 was greater than the A_2. There was marked tenderness on pressure over all the ribs and bones of the extremities. The abdomen was tender throughout, with a tender, firm liver edge felt 5 fingers below the costal margin. The spleen was enlarged and palpable felt 1½ fingers below the costal margin. There was no fluid in the abdomen. His reflexes were normal. At the time of admission, the red blood count was 2,900,000, hemoglobin 7.4, hematocrit 28. The mean corpuscular volume was 95, the mean corpuscular hemoglobin 25.5, and the mean corpuscular hemoglobin concentration 26.4. The corrected sedimentation rate was 3. During his stay in the hospital his hemoglobin fell to 3.2, on the day of discharge. The white blood count on admission was 42,200 with 88 per cent polymorphonuclears, 7 per cent lymphocytes, 3 per cent monocytes, and 2 per cent normoblasts. The smear showed many target cells and large pale red cells. The fragility test showed both increase and decrease of fragility. On discharge, the white blood count was 10,000. The icteric index on admission was 28; five days later it was 5. The calcium was 4.8, phosphorus 1.2, and phosphatase 4.1. The patient received sulfadiazine therapy in the Brigham Hospital, but it was felt that it was improbable that the progressive drop in hemoglobin could be due to this treatment.

A smear was made from the mother's blood which showed definite anisocytosis with microcytes and poikilocytosis with oval forms. The patient's sister showed no achromia, but occasional polychromatophilic red cells, definite microcytes, but no macrocytes and poikilocytosis with oval cells. The hemoglobin of the mother was 12 Gm.; of the sister, 12.6 Gm. The mother's red blood count was 5,300,000, while the sister's red blood count was 4,900,000.

Examination at the Massachusetts General Hospital showed the boy to be somewhat dwarfed for his age. His height was 5 feet, 1½ inches. He was olive-skinned, had typical mongoloid facies (Fig. 300) and open fontanels. The veins were clearly outlined on the thin skin over the forehead, which contained prominent frontal bones. His nose was extremely small and sunken; the malar bones were very prominent. The maxilla was markedly enlarged (Fig. 301), covered

Fig. 300.—Patient with erythroblastic anemia showing mongoloid facies.

Fig. 301.—Expansion of maxilla in erythroblastic anemia.

by a thin mucosa extending over the palate on which the blood vessels were prominently displayed (Fig. 302). Intraoral examination showed that a normal number of teeth had erupted, and were all present except the right lower molar which had been extracted. The teeth were yellowish in color and had occasional white spots in the enamel. His first molar relationship was normal, and the incisor occlusion was also normal. The remaining three first molars were carious to the extent that the crowns were almost completely destroyed. His mother refused to have blood taken for a checkup on his blood cytology.

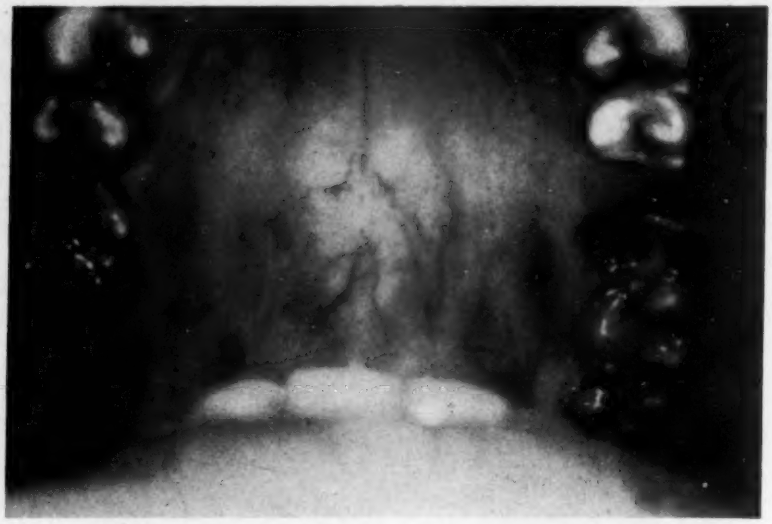


Fig. 302.—Palate with blood vessels prominently displayed.

The impression was that the patient had erythroblastic (Cooley's) anemia. X-rays were advised. Roentgen examination of the jaws shows a transformation of the spongiosa with marked osteoporosis, often spoken of as pepper-and-salt appearance (Figs. 306 and 307). In the maxilla were similar changes with compensatory lamellar striations. The crowns of the first molars were destroyed by caries (Fig. 305). X-rays of the skull (taken elsewhere) showed extensive medullary thickenings of the cranial bones with thin tables and radial striations (Figs. 303 and 304) producing a characteristic bristlelike appearance. The maxilla and malar bones were enlarged, and the maxillary sinuses seemed obliterated.

The patient was presented at the Tumor Clinic of this hospital to discuss the question of x-ray treatment to inhibit the progressive enlargement of his facial bones. He had had x-ray treatment to the spleen and liver some years ago. The roentgenologist felt that a small dose could be given to each side of the face, but that other patients with this disease who had received scattered x-ray treatment over the bones, liver, and spleen, had not improved sufficiently to survive longer than the average patient with the disease.

The mother of this boy decided that she would have x-ray treatment a little later. At present, the extraction of the three infected carious teeth has been the only treatment. The extractions were performed under local anesthesia, one tooth at a time, and were not followed by any complications. A piece

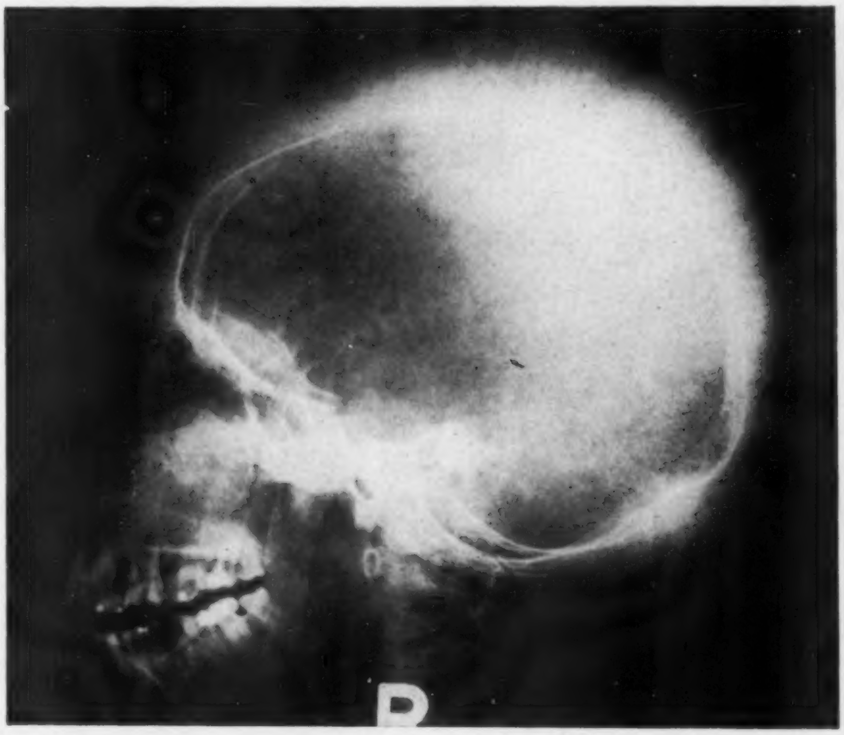


Fig. 303.—Lateral head showing bony changes in erythroblastic anemia in skull and maxilla.

Fig. 304.—Anteroposterior view of patient with erythroblastic anemia.

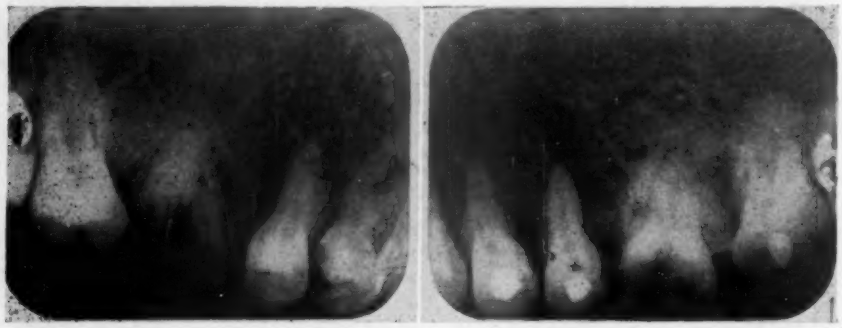
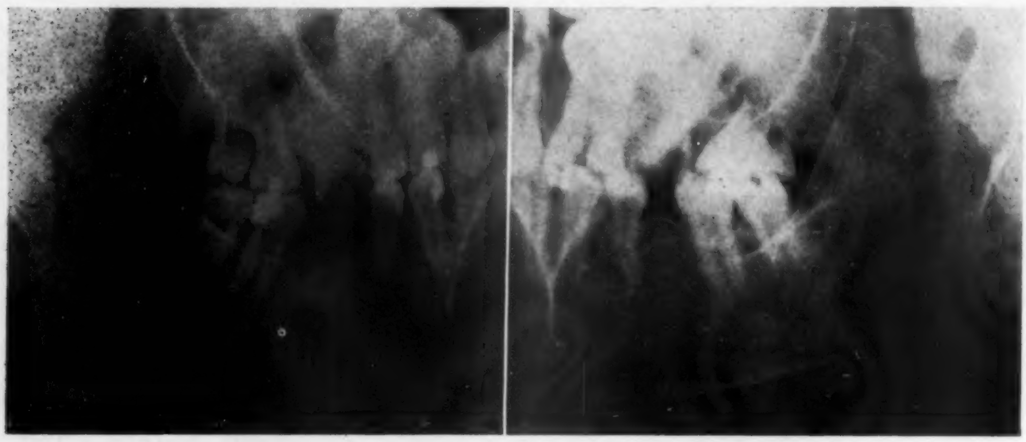


Fig. 305.—Dental films of jaw showing characteristic bony changes of erythroblastic anemia.



Figs. 306 and 307.—X-ray of mandible showing characteristic changes of erythroblastic anemia.

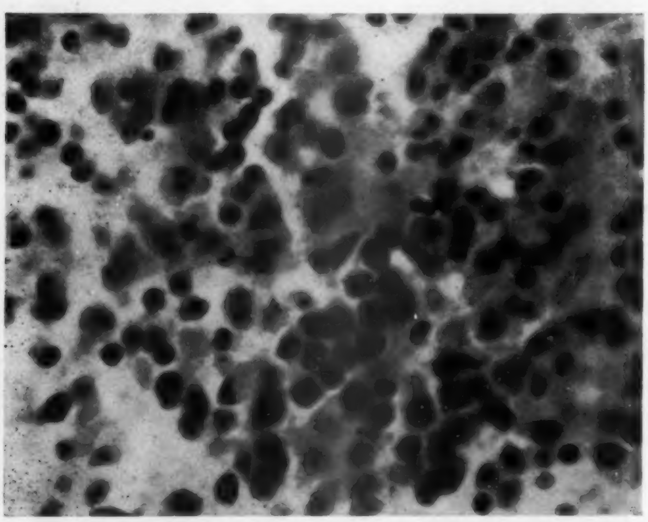


Fig. 308.—Photomicrograph of a section of bone marrow from the maxilla in the case of erythroblastic anemia.

of bone was removed from the maxilla at the time one of the molars was extracted and sent to the pathologic laboratory.

Microscopic examination showed very severe hyperplasia of the red cell series and complete replacement of the fatty marrow spaces by cellular elements of the red cell series. (Fig. 308.) There were numerous foci of normoblasts and megaloblasts, and small areas of fibrosis around some of the bone trabeculae.

VI. MANDIBULAR TRIFACIAL NEURALGIA AND INDICATIONS FOR A DECOMPRESSION OPERATION

Three cases of trifacial neuralgia resembling the types known as "tic douloureux" have been seen in our clinic in the past six months. They all had a similar onset, occurring after the extraction of teeth associated with unusual trauma of the jaw. In one case there was pressure caused by a dislodged piece of a root; in another, sclerotic devitalized bone caused irritation; in a third, a low-grade chronic osteomyelitis may have produced the disturbance. In these cases, after decompression of the nerve which is dissected free from the surrounding bone, the symptoms ceased completely. In one case the nerve was severed and, therefore, its function affected, which makes it a question of whether the symptoms disappeared because of anesthesia produced in the trigger zone, or whether they were eliminated because of the operation for decompression of the nerve.

The operation is sometimes associated with considerable bleeding. In one case considerable hemorrhage resulted, which was quickly arrested by the use of thrombin applied by fibrin foam, kindly put at our disposal by the Department of Physical Chemistry of the Harvard Medical School.

Case 66

Decompression of Left Inferior Alveolar Nerve for Trifacial Neuralgia and Evulsion of the Infraorbital Nerve

L. B. (No. 444440), a 32-year-old man, came to the Dental Outpatient Department on April 11, 1944, complaining of severe shooting pains in the left mandible. He stated that he did not like to wash his face because it brought on an acute spasm of typical "tic" character. He was greatly hindered in his job of driving a truck.

Eight weeks before, he had had three teeth extracted on the lower left side by a local dentist who used novocain anesthesia. The day after the extractions and for the following three days, his jaw was so sore that he could not open it to chew and could only take fluids with difficulty. In time the soreness disappeared but was replaced by recurring attacks of sharp lancinating pain which lasted from one-half to two minutes. These pains were brought on by movement of the jaw in talking, drinking, and shaving; even touching his lip sometimes set off an attack. The pains were noticeably worse at night. He woke up every fifteen to twenty minutes with a new attack, especially when sleeping on his left side. There was an aura of small pinprick sensations which preceded

severe attacks by about one minute. His dentist lanced his jaw three weeks after the extractions and removed a "chip" of tooth or bone, without any resultant improvement. Attacks of pain became more frequent during the daytime. Since his diet consisted only of fluids and he got very little sleep, he had lost twelve pounds.

He presented a typical trifacial neuralgia of the left side. When the pain came on he contracted the affected part of the face (Fig. 309). Since the onset of the disease coincided with the extraction of three teeth, an operation for decompression of the mandibular nerve was advised. If that should be unsuccessful, an evulsion of the mandibular nerve would be performed. The patient said that he would rather have a numb face than the pain, and he was willing to proceed in this manner.

He was admitted to the House on April 13, 1944. The physical examination showed an old poliomyelitis with a Hoke arthrodesis and peroneal transplant to the left foot. There was no evidence of circulatory insufficiency of the feet. The rest of the examination was essentially negative. On April 14, after the usual preoperative medication, a decompression of the left inferior alveolar nerve was performed. Anesthesia was induced with intravenous pentothal sodium, and maintained with endotracheal ether and oxygen. An incision was made along the left alveolar border from the ramus to the canine region. The mucoperiosteum was dissected away from the bone, after which a window was cut with an osteotome. After removing some very dense bone from the side of the jaw, the mandibular nerve was finally exposed over a distance of 1½ inches. The left inferior alveolar artery was accidentally severed. To produce hemostasis, fibrin foam soaked in thrombin was packed into the bone cavity with gauze sponges which stopped the bleeding immediately. The mucosa was then replaced, and sutured by continuous silk sutures.

On the first postoperative day, his temperature was 100° F. He was able to swallow well and had no real pain. His lip was numb, however, indicating that besides the artery the mandibular nerve had been injured. By the second postoperative day, it was evident that the neuralgia was completely cured. The alveolar ridge was healing well. He was discharged to be followed in the Outpatient Department Dental Clinic on the third postoperative day, April 17.

When he was seen on April 20, the sutures were removed and the area was painted with zephiran. There was no swelling or tenderness. He had had no more attacks of trigeminal pain in the interim. He was seen on May 3, when the anesthesia in his lower lip was still present and the former pains had not recurred.

When seen on July 24, he complained again of neuralgia, but this time in the region supplied by the second division of the trigeminal nerve, with a trigger zone on the side of the nose. The infraorbital nerve was injected with monocaine by an extraoral approach. While the anesthesia lasted, the patient said he could wash his face for the first time in three months. Neurectomy of the infraorbital nerve was advised.

On July 28 a neurectomy was performed under gas-oxygen-ether anesthesia with the usual premedication. An incision was made in the upper sulcus. After

Fig. 309.—Patient with trifacial neuralgia.

Fig. 310.—Photograph of nerve emerging from infraorbital foramen.

retracting the lip and very carefully preparing the mouth with zephiran, the incision was carried through the periosteum, which was stripped back until the infraorbital nerve and foramen came into view. A hook was passed below the infraorbital nerve (Fig. 310), after which the entire trunk was seized and evulsed from the infraorbital canal. About 1 inch of nerve was thus removed. The peripheral part of the nerve was wound up on a hemostat and evulsed from the skin. The incision was closed with silk sutures.

On July 30 the patient had some swelling and pain, particularly referred to the ear. From the second day on, however, he improved and was comfortable on Aug. 3, 1944, when he was discharged to the Outpatient Department with a good result.

Case 67

Decompression of Mandibular Nerve for Trifacial Neuralgia

C. F. (No. 436116), a 61-year-old woman, was referred to this hospital with a chief complaint of pain in the left lower jaw for four months.

Four months before, an abscessed first molar was extracted. It healed well, but the pain continued. She complained of pain in the jaw and gum, and in the tongue. In the last six weeks it had been extreme, and she had lost 16 pounds. She had three alcohol injections in the anterior part of the jaw without much benefit.

The pain was very acute, and felt like a "corkscrew bored into the jawbone." It radiated to the inside of her cheek and gingiva, and the side of her tongue. The outside of her face was sensitive and painful to touch during the attacks. These came on usually at night, but she generally had about two attacks during the day. Wiggling her tongue, hitting her jaw, or any shock would set the attack off. The pain started between the left lower canine and first premolar.

Physical examination showed a definite swelling over the site where the alcohol injections had been made at the region of the mental foramen, also some swelling of the gingiva, most marked below the canine tooth. Her tongue was somewhat smooth on the edges. There was anesthesia over the lateral half of the left lower lip and the skin of the chin.

She was admitted to the Emergency Ward on February 1, where sedatives were discontinued so that the mandibular nerve at the mandibular foramen could be blocked with novocain for a test, when an attack came on. She had an acute attack at 2:45 that afternoon. The pain occurred every four to five seconds. A mandibular nerve block was done, and the pain subsided after eight minutes.

X-rays taken on the same day revealed what appeared to be some increase in density about the socket of the recently extracted left lower molar, which was probably due to a low-grade osteomyelitis resulting from the abscessed tooth (Fig. 311).

She was admitted to the House on February 3 for decompression of the mandibular nerve. After the usual preoperative medication, and under endotracheal nitrous oxide, oxygen, and ether anesthesia, the left lower molar was

first extracted. Next, an incision was made in the gingival mucosa extending from the ramus to the premolar tooth. This incision was extended at each end over the outer surface of the mandible. A mucoperiosteal flap was lifted from the bone and retracted. By means of a gouge, the cortex of the outer surface was removed to the level of the mandibular canal. In the area previously operated on at another hospital, a great deal of soft, and later sclerotic bone, was found. The latter bone was in contact with the mandibular nerve, and after removing it about 2 or 2½ inches of the mandibular nerve became visible. The nerve was freed from any bony impingement, after which sulfanilamide powder was inserted, and the mucoperiosteal flap returned and held by a continuous silk suture.

Fig. 311.—X-ray showing osteolytic area where a tooth was excised surrounded by a dense, sclerotic area of bone (*S*).

Pathologic examination of three dark red pieces of spongy bone measuring 1 cm. resulted in a pathologic diagnosis of low-grade chronic osteomyelitis.

The postoperative course was uneventful, and she was discharged on the fourth postoperative day to be followed in the Outpatient Department. She was seen on February 11, and at that time the sutures were removed. The ridge was well healed. She had had no neurologic symptoms since the operation. She was permanently discharged, to return if she should have recurrent symptomatology.

VII. TUMORS OF THE JAWS

Three tumors only will be presented. The first is an unusually large fibroma of the maxilla, a so-called epulis fibromatosa; the second is a late case of basal-cell adamantinoma or low-grade adenocarcinoma causing unusual facial deformity; and the last is a small cementoma which is added because the interpretation of the x-ray presented some difficulty. Its appearance was not unlike that caused by a salivary stone in the submaxillary gland, which was seen in another patient.

Case 68

Fibroma of the Maxilla

L. E. (No. 442614), a 71-year-old woman, was first seen in the Outpatient Department on March 27, 1944, complaining of a large mass about the size of a pigeon's egg in the region of the upper left canine tooth, extending from the second premolar as far as the median line of the maxilla.

The patient believed that it had started to grow two months before, progressing rapidly until it was about 2.5 by 1.5 cm. in size. She had pain and had brought with her some medicine which she rubbed into it to get relief. Sometimes this medicine burned the tissues. There was some bleeding; she said that when she awoke in the morning her mouth was "full of blood."

Examination showed the mass to be firm with a hard base. The posterior half had a dull reddish pink color, and the anterior part had a bright red color simulating the appearance of a giant-cell epulis (Fig. 312). The adjoining premolar and cuspid were loose. The physical examination also showed the patient to be extremely obese; she weighed 202 pounds, and had dyspnea on exertion. Her lips were a bit cyanotic, and she had a large incisional hernia in the site of an old right nephrectomy. There was also some cardiac decompensation. In consultation with the Anesthesia Department, it was decided to operate with local anesthesia.

Fig. 312.—Photograph of fibroma of maxilla.

She was admitted to the House with a diagnosis of fibroma of the upper jaw. On April 10, 1944, the usual preoperative medication was given and the fibroma excised. Two per cent monocaine with epinephrine was used for an infraorbital block, and for local infiltration on the outside and inside of the maxilla. An incision was made with the endothermy knife about 1 cm. away from the tumor. With an osteotome, the outer cortical plate was incised and the tumor, including

three teeth, removed en bloc. The tumor bed was coagulated with the electrocautery, after which a boric strip pack was applied and held in place with three silk sutures through margins of the wound. The left upper second molar, and the right upper second incisor were extracted because of their carious condition. The pathologic diagnosis was fibroma of the maxilla (Fig. 313).

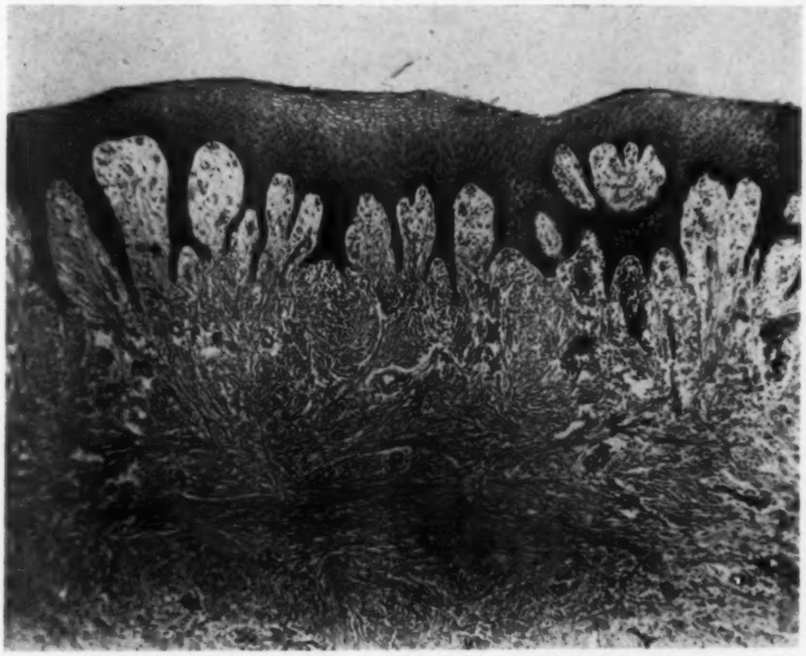


Fig. 313.—Microphotograph showing fibroma lined by stratified squamous epithelium.

The postoperative course was smooth, and she was discharged on the first postoperative day, to be followed in the Outpatient Department. On April 14 the excised area was found covered with granulation tissue. The sutures were removed and the wound irrigated with warm saline, and painted with zephiran. When she was seen on April 26, the wound was healing well. There was a fairly large piece of bone exposed which was undergoing necrosis from coagulation. This was removed on May 3, and on May 10 the patient was discharged, relieved.

Case 69

Basal-Cell Adamantinoma or Low-Grade Adenocarcinoma

W. H. (No. 443296), a 55-year-old man, was first seen by the Tumor Clinic of this hospital on March 31, 1944. His chief complaint was a large growth involving the entire maxilla, filling the nostril, and causing marked expansion and protrusion of the upper jaw (Fig. 314).

About a year before, this man had developed a lump on the left side of his jaw, which was "lanced." X-ray treatment was given later, and the lump stopped growing for a while. After a few months it again began to grow until it involved the entire maxillary bone. He complained of bleeding from the nose.

On examination the maxilla was found markedly enlarged (Fig. 315). The entire center of the hard palate was missing, presumably where an incision had been made by his physician several months earlier. The present disease occupied not only the entire alveolar process on both sides, but obviously involved the antra. It was felt by the Tumor Clinic and the Dental Department that basal-cell adamantinoma or adenocarcinoma were the most probable diagnoses.

Fig. 314.—Photograph of patient with advanced tumor of upper jaw.

Fig. 315.—Intraoral photograph of patient with basal-cell adamantinoma.

X-rays of the jaws taken the same day showed the maxillary antra, nasal passages, and right ethmoids to be diffusely hazy. A destruction of the medial walls of the antra, the anterior margin of the maxilla, the lateral walls of the

right antra, and a portion of the malar bone on the right was noticed. There appeared to be lacelike areas of calcification within the tumor, which, it was felt, might represent residual trabeculation of normal bone rather than calcification within the tumor tissue. They showed extensive destruction of the entire hard palate.

A biopsy was taken in the Dental Clinic on March 31, from the right side of the maxilla at the most prominent part of the swelling, where the blood vessels could be seen beneath the mucosa. The pathologic diagnosis was adamantinoma, though a very low-grade adenocarcinoma could not be definitely ruled out (Fig. 316). Such tumors are also classified, particularly in the foreign literature, as basiloma or cylindroma. They grow rather slowly and do not metastasize very easily.

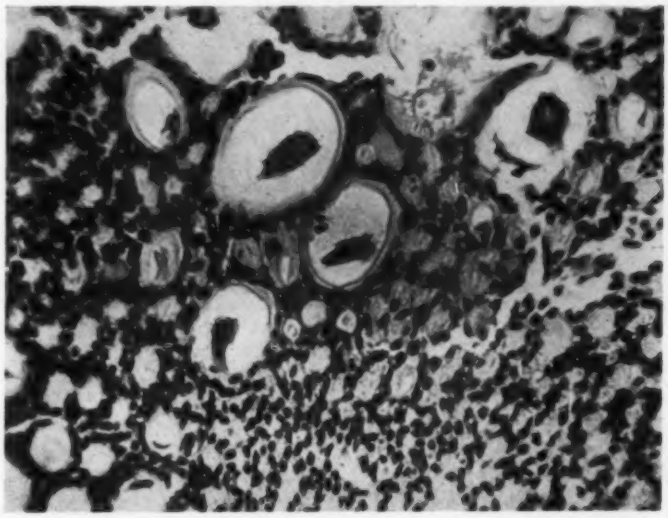


Fig. 316.—Microphotograph of basal-cell adamantinoma.

In the Tumor Conference on April 11, no one felt that the lesion was surgically approachable. Since the patient had already had a trial of radiation, all that could be accomplished by this might be a staying of the activity. It was agreed that the patient should be returned to the care of his local doctor.

Case 70

Cementoma

N. M. (No. 440015), a 34-year-old woman, was admitted to the hospital on March 3, 1944, with a diagnosis of cementoma.

The physical examination revealed, in addition to the cementoma of the left mandible, an old upper respiratory infection, enlarged but nontender inguinal nodes, and moderate bilateral ankle edema. She was considered a poor anesthetic risk because of her cold.

The x-ray showed (Fig. 317) a calcified body which might be in or medial to the jaw. An occlusal film showed it to be a central calcified tumor.

On March 4, after the usual preoperative medication, and under endotracheal nitrous oxide, oxygen, and ether anesthesia, an incision was made along

the alveolar crest on the left side of the mandible. The mucoperiosteum was reflected, and a window about 1 by ½ inch was cut into the bone. A hard calcified mass was located, somewhat attached to the cortex of the bone. It was detached with an osteotome and removed. The nerve was seen beneath the cementoma. It was preserved, and the incision closed with silk sutures.

Fig. 317.—X-ray showing cementoma of mandible.

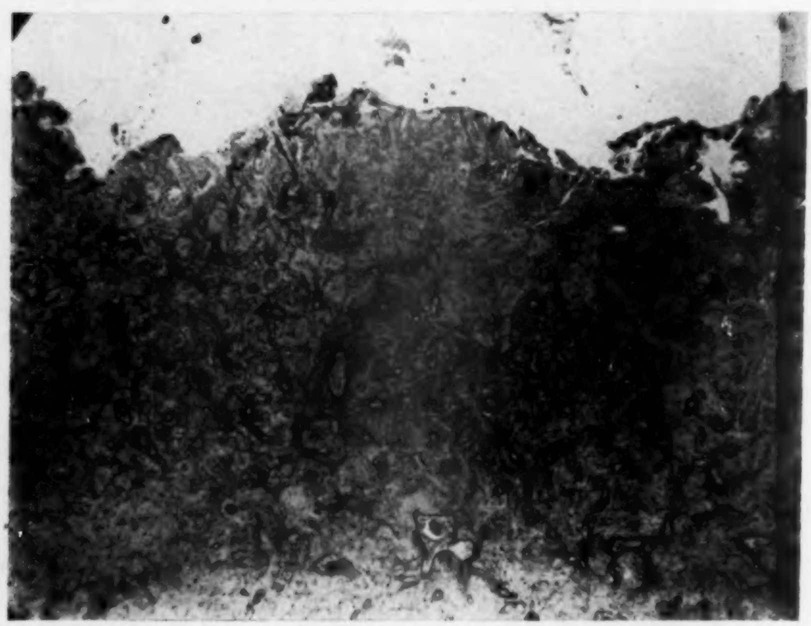


Fig. 318.—Photomicrograph of cementoma.

The pathologic diagnosis was cementoblastoma (Fig. 318).

The postoperative course was smooth, and she was discharged from the hospital on the fourth postoperative day completely relieved of her neurological disturbance.

Discussion.—The x-ray findings in this case may be mistaken for calculus in the submaxillary gland. A private patient with this condition was seen by one of us (K. H. T.) at this time. He gave a history of a swelling at the opening

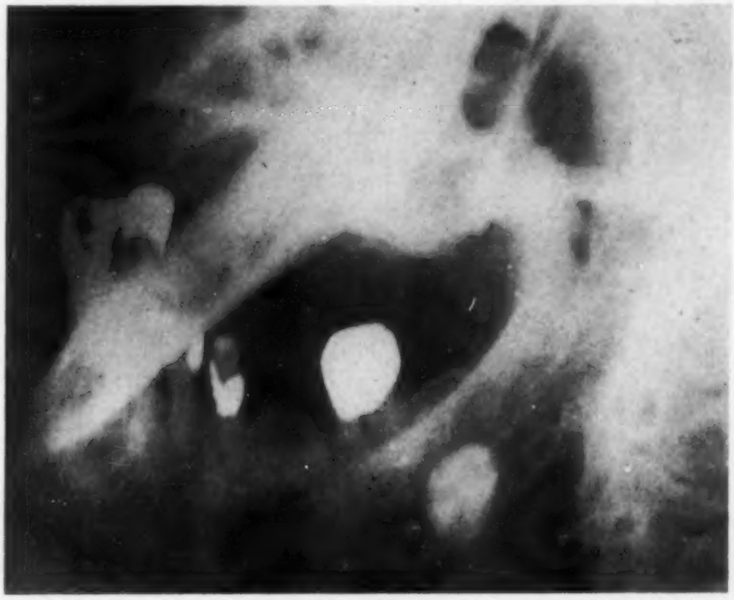


Fig. 319.—X-ray of submaxillary calculus superimposed on mandible.

Fig. 320.—Removal of calculus in submaxillary gland from intraoral approach.

of Wharton's duct during the latter part of February. He had a cold at the time, so he paid no attention to the swelling which did not annoy him greatly. On the morning of April 5, however, he felt a roughness under his tongue. On looking into a mirror, he noticed a yellowish area, and when he moved his

tongue, a salivary stone, about the size of a pea, came out. There was no soreness or inconvenience until late that evening. Looking in a mirror again, he saw a considerable amount of pus come out of the submaxillary duct when he lifted his tongue. X-rays were taken which showed three more stones in the duct, and a large and small stone in the submaxillary gland. From then on,

Fig. 321.—Photograph showing stones removed from submaxillary gland and submaxillary duct.

his mouth and jaw remained sore and inflamed until the three stones in the duct came out of their own accord on April 10. Almost immediately the soreness cleared up. An x-ray taken on April 17 showed the large stone remaining in the gland (Fig. 319). It was removed surgically from an intraoral approach, through an incision made over it in the floor of the mouth (Fig. 320). The stones removed from this patient are shown in Fig. 321.

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The Clinic of the Department of Oral Surgery of the University Hospital and School of Dentistry, University of Michigan

ANODONTIA: REPORT OF A CASE ASSOCIATED WITH ECTODERMAL DYSPLASIA OF THE ANHIDROTIC TYPE

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THE syndrome of hereditary ectodermal dysplasia, anhidrotic type, has been reported frequently during the past few decades. Forty-five cases have been described with sufficiently accurate detail to merit acceptance. This report of an additional case is believed warranted because of the presence of two interesting associated features: (1) deficiency of the lacrimal gland secretion, and (2) congenital anodontia.

The features characteristic of ectodermal dysplasia may be grouped into the triad of (1) hypothichosis, (2) anhidrosis and asteatosis, and (3) anodontia. Intensely interesting is the frequent individual variation in the expression of the primary triad and associated secondary features. No two cases manifest the same signs and symptoms to the same degree. Conspicuous associated secondary manifestations of the dysplasia are: abnormality of the nails; hyperpyrexia; deficiency of the lacrimal, pharyngeal, conjunctival, and salivary glands; protuberant lips; depressed saddle-nosed appearance; atrophic rhinitis; and dysphonia.

Aplasia of the dental structures may be classified as (1) total anodontia, a complete absence of both deciduous and permanent dentition, and (2) partial anodontia, an absence of one or more of either the deciduous or permanent dentition but with the presence of teeth. In cases with the latter classification some patients have demonstrated only one or two maxillary or mandibular teeth. Other interesting cases have presented unilateral absence of teeth in either jaw, also partial eruption of the mandibular teeth with total absence of the maxillary teeth or a reverse situation.

Thoma[3] described the pathogenesis of anodontia as a part of the suppression of the development of the ectodermal tissue from which the tooth buds are developed. In its most severe form, it presents a total aplasia of the dental lamina and subsequent absence of development. If the ectodermal development is interfered with later in fetal life, the dental lamina may have formed and produced buds for the enamel organ of the deciduous dentition. It is possible that

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the embryonic bud for the permanent dentition will fail to materialize. This explanation may account for the observed cases of complete deciduous development and eruption with total absence of the permanent teeth.

A normal development of the maxillary and mandibular bones has been described in the majority of the cases. A characteristic partial absence of the alveolar ridges of the maxilla and mandible is most frequently observed. This effects an appearance of underdevelopment of the bone which is not necessarily true, because the abnormal ridge is a resultant of the failure of stimulation by the erupting teeth. Several authors have reported a satisfactory development of the alveolar ridge, but do not explain the origin of the stimulation factor for its development.

The recognition of true anodontia is facilitated by its association with the triad of signs previously outlined. The marked dysplasia of the skin with maldevelopment of its secondary factors should suggest the diagnosis. A differential diagnosis must include consideration of progeria, hypothyroidism, congenital syphilis, and mongolism.

A perusal of the available literature reveals interesting variations in the associated ectodermal dysplasia in anodontia cases. A case of partial anodontia is reported by Etheridge,[5] in which the patient was totally edentulous in the left side of the mandible with complete dentition in the right maxillary and mandibular processes except the central incisor teeth. In the left side of the maxilla there was present only the first molar and second deciduous molar and cuspid. A neurotrophic etiology was postulated and was supported by the presence of hemiatrophy of the left side of the entire body associated with left side alopecia. Higgins and Kazanjian[4] demonstrated a case to Dr. Kurt Thoma of an 8-year-old boy with multiple hypertrophy of the facial structures, including the hair and bones, and with an extensive gingival hypertrophy. Clinical examination revealed total edentulism, but x-ray examination disclosed unerupted deciduous and permanent teeth.

The facial expressions and appearance of the affected individual assume an adult characteristic early in life. This is accentuated by the evident closed vertical relation of the jaw. Thoma emphasized the cosmetic changes which occur following the artificial replacement of dentition. The profile assumes a more normal proportion. This phenomenon supports the contention that normal development of the maxilla and mandible has occurred and is in proportion to development of other facial bones. The physiologic muscular function may stimulate the inherent growth factor. The maxilla is usually unaffected by total anodontia and generally assumes normal proportions unless some nasal obstructive process is present. The maxilla may be in a retrusive position in patients who have saddle noses and other facial anomalies. Alveolar ridges are generally absent as a result of loss of stimulus from eruptive dentition.

Willner[6] reviewed 125 cases of anodontia in an effort to classify the anomaly. He selected fifty of the more classic and completely described cases and arrived at a workable analysis. He was able to list twelve cases of total anodontia involving both mandible and maxilla, in only five of which the total anodontia included the absence of both deciduous and permanent dentition. It is very probable that many cases of anodontia have been misdiagnosed previous to the advent of the x-ray. It is highly probable that in some of the cases the perma-

nent teeth were unerupted and the deciduous teeth extracted in order to facilitate the eruption of the permanent ones. The patient may have been observed for only a few years with no evidence of permanent dentition and a subsequent erroneous diagnosis of anodontia made. Such cases have been reported and modern investigators question the diagnosis in view of lack of x-ray evidence.

CASE REPORT

W. R., a white boy 9 years of age, was first seen at the University Hospital Pediatric Clinic on Aug. 10, 1942. The child's chief complaint was that he had "never had teeth."

Family History.—The mother, aged 32 years, was living and well. The father, aged 39 years, was a traumatic cripple who gave a history of intermittent attacks of peptic ulcer. There were eight siblings: two girls, one aged 4 years, the other 14 years; and six boys ranging in age from 6 to 12 years. All of the siblings were living and well, all normal in appearance and in systemic development. No ectodermal dysplasia could be demonstrated in any of the siblings of the parents. There have been no miscarriages. No hereditary or chronic disease of the ectodermal system was admitted or demonstrated on either the maternal or paternal side. Syphilis by name or symptom was denied. Inheritable diseases, i.e., hemophilia, mental dyscrasias, or allergic manifestations, were likewise denied.

Birth and Developmental History.—The patient was delivered spontaneously at full term without complicating features. The mother had typhoid fever during the pregnancy. The child's health during the first few weeks of life was, in general, poor, and he was not expected to live. He always has had some ear trouble. The child sat erect, walked, and talked at normal age. The child's hair did not develop, even in poor form, until 6 years of age. As a result of a very poor appetite and lack of weight gain in infancy, the child was placed on numerous formulas. The cod-liver oil and orange juice intake was always adequate. He was never known to have sweated, and he seldom, if ever, cried tears. The teeth never erupted.

Past Medical History.—The patient had measles at 3 years of age, mumps and whooping cough at 3½ years, and varicella at an undetermined age. Frequent and rather persistent attacks of bilateral otitis media were mentioned. Pneumonia was experienced at 1½ years of age with no demonstrable sequelae.

Present Illness.—The patient was referred to the University Hospital Oral Surgery Department because of the congenital absence of teeth and a chronic nasal discharge. The mother stated that the child never had sweated or cried tears. She further remarked that it was necessary to bathe the child as frequently as five or six times a day during the hot summer months in order to keep him cool and comfortable.

Physical Examination. General.—This 9-year-old white boy was rather apathetic and small of stature for his chronological age. He was 50½ inches tall. The weight was 59½ pounds. The facial expression was that of a mature adult with pinched cheeks but very prominent and protuberant lips (Fig. 1). The child's response to conversation was noticeably limited and reserved. There was a retired indifference to his surroundings.

Head.—The skull was characterized by the prominence of the frontal bosses and the occipital process. The scalp hair was pale yellow white in color and quite thin in diameter. The individual hairs were of varying lengths and very sparse but quite uniformly distributed over the entire scalp (Figs. 1 and 2). The hair did not exfoliate very easily. The eyebrows were conspicuously thin, especially the lateral two-thirds, and were of the same yellow-white color as the scalp hair. The cilia of the lids were almost completely absent, there being only a few incompletely formed upper lid cilia.

Eyes.—The external ocular examination was negative except for moderate superficial bulbar and palpebral conjunctival injection and superficial small linear nebulous scars of the bilateral cornea. The corneal horizontal diameter was 11 mm. O.U. There was no anomaly of the iris or lens in either eye. With 2 per cent fluorescein dye there was revealed, under slit-lamp examination, a diffuse, irregular, and extensive superficial punctate staining of the cornea. The character of this staining of the cornea resembled that frequently seen in desiccation of the cornea following exposure in comatose states. There was no abnormality of the lacrimal drainage system.

The funduscopic examination revealed no abnormality in the fundus in either eye.

Repeated Schirmers' tests for the efficiency of the lacrimal secretion gave the following readings:

	Oculus Dexter	*Oculus Sinister*
6/19/43	12.0 mm.	14 mm.
6/21/43	6.0 mm.	10 mm.
6/22/43	8.0 mm.	5 mm.
7/ 9/43	3.5 mm.	5 mm.

The low readings of the above tests in combination with the history of infrequent psychic tears and the staining reaction of the cornea led to the diagnosis of congenital deficiency of the lacrimal secretion each eye.

The patient was refracted and accepted the following correction under paredrine and homatropine cycloplegia:

O.D.	+0.75 sphere	+3.00 cyl.	axis 111 = 6/9-2
O.S.	+0.50 sphere	+3.00 cyl.	axis 78 = 6/9-3

Glasses were ordered and the patient was instructed to use Ringer's solution six to seven times a day to supplant the deficient lacrimal secretion.

Nose.—The broad, saddlelike nasal base was conspicuous. The nares were large (Fig. 1). The turbinates were slightly atrophic. There was a moderate septal deflection to the left. A foul, purulent, crusted green discharge was present bilaterally. Definite atrophic changes with pus on the floor of the nares was typical of atrophic rhinitis.

Ears.—The auricles were not abnormal in shape (Fig. 3), but there was a very oblique insertion which made the ears most conspicuous. The external auditory canals were clear except for a moderate amount of cerumen. The tympanic membranes were markedly retracted bilaterally. There was evidence of a left tympanic membrane perforation. No evidence of acute or chronic otitis media was observed. No definite indication of hearing acuity loss could be demonstrated.

Fig. 1.—Lateral view of head showing protuberant lips and adult facies.

Fig. 2.—Top of head showing lanugo hair.

Sinuses.—The sinuses were normal to gross examination and transillumination.

Oral Examination.—The patient presented total edentulism. The alveolar ridges were flat, thin, and almost wanting, with sharp definition of the alveolar mucous membrane, presenting a clinical appearance of atrophy. The maxilla was broad and flat; the mucous membrane of the cheeks was continuous with that covering the alveolar ridge. The mandible appeared to be of normal size and development according to the chronological age of the patient (Fig. 4). The tongue was minimally coated. The mucous membrane of the pharynx was moderately injected, and a marked ozena was associated with a severe postnasal purulent dripping discharge. The tonsils were small and cryptic with minimal sepsis. The nasal pharyngeal adenoid tissue was minimal and coated with foul exudate. The larynx demonstrated definite atrophic changes. The salivary glands appeared grossly normal.

Fig. 3.

Fig. 4.

Fig. 3.—Left auricle.
Fig. 4.—Complete edentulism. Note almost complete absence of alveolar ridges.

Neck.—The neck was symmetrical and there was no gross evidence of deformities. The thyroid was not palpably enlarged. Several small, firm, nontender, anterior cervical chain lymph nodes were palpable. The mandible and chin were prominent.

Skin.—In general, the skin was smooth, thin, elastic, and minimally atrophic, as if long exposed to the elements. The superficial venous system was most conspicuous through the thin skin. The skin further presented a mild roughness and brawny desquamation. Scabietic lesions were present in the inguinal, axillary, and abdominal folds, as well as on the wrist, torso, arms, legs, and pubic area. The nails of both fingers and toes were not very unusual except that they were atrophic to a mild degree and terminated in moderate points

Fig. 5.—Dorsal view of hands.

Fig. 6.—Palmar view of hands, showing atrophic changes of skin.

(like pen tips). The same atrophic skin changes were observed on the hands and were probably accentuated by exposure to the elements (Figs. 5 and 6).

Chest.—The thorax was symmetrical; no obvious anomalies could be demonstrated. The lungs were normal to auscultation and percussion. The heart was normal.

Abdomen.—The abdomen was scaphoid. The musculature was prominent and presented good tonus. There was visible peristaltic pattern beneath the somewhat thin abdominal wall. No palpable masses, no hernia, and no areas of tenderness could be demonstrated.

Genitalia.—The penis was somewhat hypertrophied, the testicles normal.

Extremities.—The skin was shiny, smooth, and thin. Numerous excoriations were observed in association with multiple small vesicles.

Spine.—The back and spine were symmetrical and straight; no gross anomalies could be observed.

Neurological Examination.—Neurological examination was definitely normal. Normal physiologic reflexes were present. The sensorium was normal.

Laboratory Procedures. Blood Studies.—Kahn's serologic examination was negative. Blood phosphorus 5.6 mg. per cent, blood calcium 10 mg. per cent, blood nonprotein nitrogen 10.5 mg. per cent, and blood phosphatase 2 n.s. In general there was no conspicuous deviation from the normal levels for the various blood factors.

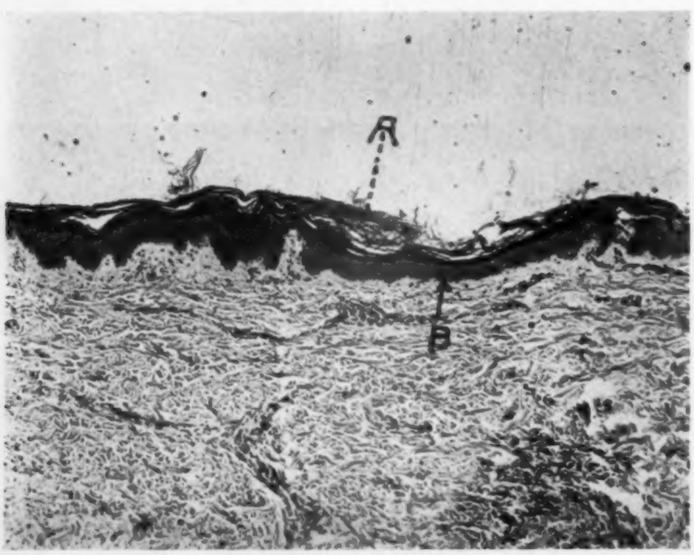

Fig. 7.—Cross section of biopsy of skin from flexor surface of right forearm.

Basal Metabolic Rate.—The basal metabolic rate, first determination, was -8. The pulse rate was 62, and the temperature 98.4° F. A reading of -8 is within the limits of normal. However, the true rate may be slightly lower when consideration is taken of the fact that the above reading is for the first determination.

Pathologic Examinations.—A punch biopsy of the flexor surface of the right forearm was taken. The specimen consisted of a portion of tissue cov-

ered by cornifying stratified squamous epithelium (*A*) without underlying accessory skin structures. The stroma was dense and there were a few perivascular infiltrations of lymphocytes. There was an increase in pigmentation of a very minimal degree (*B*) (Fig. 7).

A specimen of scalp hair was examined microscopically and was found to be unusually fine. The average area in cross section was 1,054 square microns, with a minimum of 641 and maximum of 1,838 square microns. The hair is moderately flattened as is shown by the average cross section index of 0.64 (minimum 0.55 and maximum 0.79). Furthermore the hair is unusually uniform both in size and in amount of flattening.

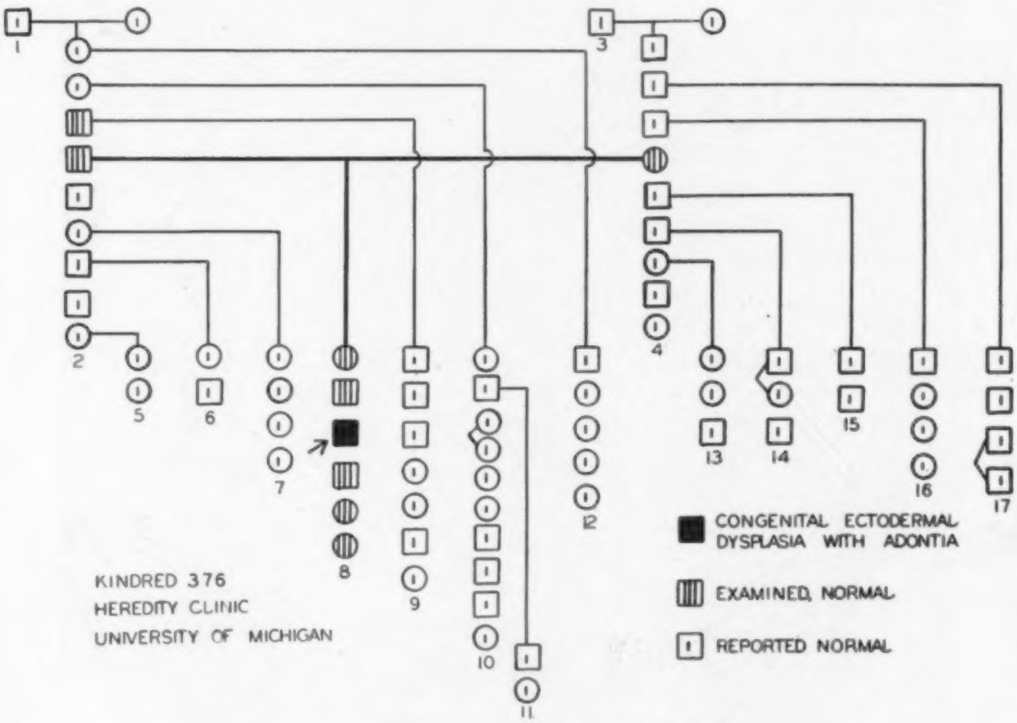

Fig. 8.—Pedigree. The patient described is indicated by arrow.

Genealogical Table.—A pedigree, based largely on hearsay evidence, is presented (Fig. 8). No living members of the family could recall any antecedent, sibling, or decendant, living or dead, who manifested changes closely or in any degree simulating those found in the patient. The pedigree differs from the conventional diagram by having the children of a single union arranged vertically rather than horizontally. The sibships are numbered 1 to 17, and a particular person will be referred to by means of the sibship number followed by a number denoting his or her position (from top to bottom, corresponding to birth order) within the sibship. Thus 8-3 refers to the propositus. Serologic tests of blood and saliva did not reveal any evidence that the legal parents of sibship 8 were not also the biologic parents.

X-ray Examination.—Examination of the paranasal sinuses demonstrated underdevelopment of all sinuses. The left frontal has budded, but there was no evidence of frontal sinuses on the right. There appeared to be a minimal

thickening of the mucous membrane lining both maxillary antra. The ethmoids were clear. Sphenoid sinuses appeared underdeveloped but were clear. A single lateral stereoscopic view of the skull revealed no evidence of abnormality of the sella turcica. The total absence of maxillary and mandibular teeth was clearly demonstrated on a single lateral jaw plate (Fig. 9).

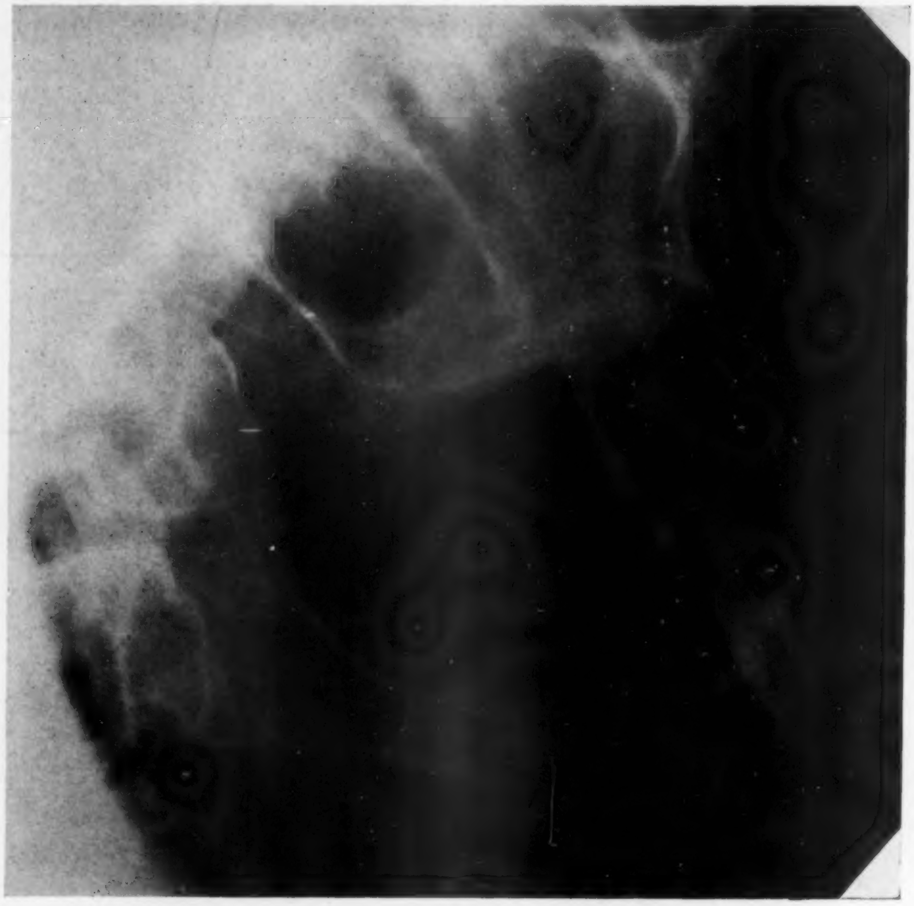

Fig. 9.—X-ray of mandible showing anodontia.

COMMENT

The patient was referred to the Department of Prosthetic Dentistry in the School of Dentistry, University of Michigan, where, under the direction of Dr. Richard Kingery, complete artificial dentures were constucted. It was suggested to the parents that the necessity for periodic adjustment and, probably, reconstruction was obvious. Following the insertion of the denture, the boy's profile assumed more normal proportions.

The poorly defined alveolar ridge of the mandible added to the problem of construction and retention. It will be interesting to observe the effects, if any, that the denture will have toward effecting a stimulation of the ridge.

DISCUSSION

Many theories of the etiology of anodontia, associated with ectodermal dysplasia, have been proposed by various investigators. The theory of en-

docrine dyscrasia is one that has received much support. In 1928 Downs[1] completed a study of 647 patients who were affected by a wide range of endocrine disturbances and concluded that there was evidence of regularity in the appearance of dental anomalies in endocrinopathic patients. He deduced, however, that no specific dental anomaly could be considered pathognomonic of any particular type of endocrine dyscrasia. It is interesting to note that dental anomalies do occur more frequently in endocrinopathic patients than in normal individuals. Chemical and hormonal influence of maternal toxic infections on the developing fetus is easily postulated, but is proved with difficulty. One cannot, however, deny the possibility of such environmental influence.

The hereditary character of the anomaly has been generally accepted, recognition being forced by the weight of rapidly accumulating evidence. Numerous pedigrees have been reported. Anodontia associated with ectodermal dysplasia of the anhidrotic type has been commonly believed to be a sex-linked recessive character. In some pedigrees infrequent females have been known to manifest the syndrome, but this is not a fatal objection to the hypothesis, for discrepant females also have occurred in the pedigrees of other traits known to be sex-linked in inheritance. For example, heterozygous females may manifest modified pictures of color vision anomaly, hemophilia, and Leber's hereditary optic atrophy. It is not inconceivable, then, that the syndrome characterized by anodontia is sometimes incompletely dominant in the female.

An incomplete or mild form of the syndrome, namely, hypotrichosis and nail dyscrasias associated with partial anodontia, has been repeatedly reported as a simple autosomal dominant trait. A few reports have postulated a simple recessive pattern of transmission. It may well be that anodontia and its associated abnormalities is inherited through different genes in different families.

No evidence was found that the anodontia and associated dysplasias of the case here reported is inherited. No other member of this family, so far as known, exhibited any similar defect. It is therefore possible that in this family the character is not hereditary. On the other hand, it would be theoretically possible for a character of this type to be hereditary and still not to have appeared in any other members of the family known to our informants.

A sex-linked mode of heredity, such as has been postulated in some other kindreds with anodontia, might be transmitted unobserved through the females for a number of generations. Each of the sons of a carrier female should have a one to two chance of having the trait. In this kindred both the mother and the grandmother of the propositus must, on this hypothesis, have been carriers. The mother had three sons, only one of whom shows the character, and the grandmother had six sons, none of whom showed the trait. The chance that only one or less out of nine males would exhibit the trait, when each has a one to two chance of inheriting it, is 0.0195, which is one chance in about fifty. This probability would be further reduced slightly by the occurrence of a normal male in sibship 13, who, if the grandmother was a carrier, would have a one to four chance of inheriting the defect. Such a mode of heredity would therefore be possible in this kindred, though unlikely.

A hypothesis of a dominant mode of heredity with a very low penetrance seems untenable in this case. A recessive mode of heredity would be theoretically possible, but very unlikely in view of the absence of any known consanguinity between the parents. There remains the possible hypothesis that the characters shown by our patient have been produced by a mutation. Although traits to be hereditary must presumably always have originated in a mutation in either the individual concerned or in an ancestor, there is no way of proving that a mutation actually is responsible for the characters of this boy.

SUMMARY

Congenital total anodontia is relatively uncommon. The associated ectodermal dysplasia of our patient would indicate interference with the ectodermal system in early fetal life. Other cases have been reported that indicate a sex-linked heredity for the syndrome. In this kindred there is no other known instance of ectodermal dysplasia. It is theoretically possible, nevertheless, that the character may have been transmitted as a sex-linked recessive trait through the mother and grandmother.

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HISTOLOGICAL CHANGES IN THE ENAMEL ORGAN RESPONSIBLE FOR ENAMEL HYPOPLASIA

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ENAMEL hypoplasia is an outstanding dental defect. It has been widely discussed, especially the clinical manifestations, the chronology, and the structural changes produced in the enamel, but the histological changes in the enamel organ which are responsible for the production of the lesions have not been thoroughly described. Hence, it seems desirable to report some of the histological changes observed in the human jaws which are responsible for the production of hypoplastic enamel. A study of these changes may be helpful in our better understanding of the process of enamel formation.

REVIEW OF THE LITERATURE ON ENAMEL HYPOPLASIA

The earliest reference to hypoplastic enamel defects was that of Bunon[1] when he described "erosion" of the teeth due to rickets, measles, and scurvy.

Hutchinson,[2] in 1858, gave a detailed clinical description of enamel hypoplasia attributed to syphilis. Zsigmondy,[3] in 1893, advocated the name, "enamel hypoplasia," which is the term still used to describe developmental defects in the enamel.

Berten,[4] Walkhoff,[5] Erdheim,[6] Gottlieb,[7] Black,[8] and others[9, 10] have discussed enamel hypoplasia and suggested a variety of factors as responsible for the condition. Syphilis,[7] exanthematous disease,[10] fever, toxins,[1, 4] and dietary deficiencies[6, 9, 11] have all been suggested as etiological agents in hypoplasia.

The more recent literature includes the detailed report of Gottlieb[7] on the histological changes in enamel hypoplasia associated with rickets. He describes it as a breakdown of normally formed but poorly calcified enamel rods. He concluded that enamel hypoplasia is due to a calcium deficiency and that degeneration of the ameloblasts is secondary to the lack of calcium in the enamel rods. Very soon after Gottlieb's report, Mellanby[9] described marked changes in the ameloblasts of puppies on a rachitogenic diet. She described alterations in the ameloblastic cells with a secretion of enamel substance forming "enamel nodules."

In 1931, Becks[11] described changes in the ameloblastic cells associated with calcium and vitamin D deficiency in which edema and degeneration of the ameloblasts characterized the process. Becks states: "Enamel hypoplasia must be traced back to a primary degeneration of the enamel epithelium, and not to a disturbance in calcification as suggested by Gottlieb." He thinks that some ameloblasts could be damaged beyond recovery, while others recover

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and produce enamel matrix as long as vitamin D is present, and that these cells will continue to produce ground substance but will not calcify it. He points out also that degenerative changes in the ameloblasts concur with simultaneous changes which take place in the odontoblasts and result in disturbed dentine formation in the cervical area.

Becks and Furuta[12] describe changes in the ameloblastic cells with the formation of enamel pearls in the degenerated epithelium of rats who have been fed a diet deficient in magnesium.

Wessinger and Weinmann have described the production of enamel hypoplasia due to the toxin effects of manganese, boron, and strontium,[13, 14] in the incisor of the rat. These defects were all associated with degenerative changes in the ameloblasts.

Diamond and Weinmann[15] describe degenerative changes in the ameloblasts of a human fetus associated with the production of hypoplastic enamel. They think that the chronology of enamel hypoplasia as reported by all other investigators is in error, and state that all of the enamel matrix is formed by 1 year of age, so that any hypoplastic defect must be initiated before that time since the ameloblasts undergo physiologic degeneration after matrix formation is completed and, therefore, cannot produce hypoplastic enamel.

Kreshover[16] in his study of human material reports enamel hypoplasia resulting from systemic disease which had its onset at 2 years of age. He describes the initial process as an abnormal secretion of the ameloblasts. This stage of abnormal secretion, he thinks, is a reversible one which will manifest itself in the mature enamel as a prominent incremental line. A more severe process is characterized by vacuolization of the ameloblastic layer, while complete cystic degeneration of the ameloblasts indicates that the final state in the pathogenesis of severe enamel hypoplasia has been reached. He states that enamel hypoplasia has a nonspecific etiology and cannot be consistently associated with any particular disease process or injury.

DISCUSSION OF MATERIAL

The material on enamel hypoplasia in the present study was obtained principally from a premature female infant of six months' gestation, whose history follows: The estimated birth weight was 1½ pounds; the actual weight at 19 days of age was 1 pound 13½ ounces; following delivery the infant was given carbon dioxide and oxygen almost continuously. The general condition of the infant was good and she was quite active, but feeding was difficult.

The first day she was fed on 5 per cent glucose, and one-half strength standard formula (Pet milk, Karo syrup, and water) was given the second day. On the tenth day elixir of thiamine was added to the formula. On the eleventh day sulfadiazine, 0.5 Gm., was added to the formula because of a purulent discharge from the eyes. This medication was discontinued on the thirteenth day. Ascorbic acid (50 mg.) and teleostrol (5 Gtt.) was added on the eighteenth day. Elixir of iron sulfate (10 Gtt.) was added on the twentieth day. The infant progressed satisfactorily, but was always a feeding problem, until the thirty-eighth day when the temperature suddenly rose from 98° to 101° F. A typical "spiked" temperature was present from this time until the

forty-third day when respiration ceased. Sulfadiazine had been administered, 0.5 Gm., in the formula every three hours on the last two days.

The autopsy findings were those of a normal six months' premature infant with lobular pneumonia of an aspiration type. Stomach contents were demonstrated in the trachea. There was marked emaciation. Otherwise the findings were negative.

FINDINGS

In the histological study of the jaws of this premature infant, a series of changes were observed in the formation of the enamel matrix which would result in hypoplastic enamel. Because of the character and severity of these changes and their slight discussion in the literature, they appear to be worthy of description. With this information one may be able to gain a better understanding of enamel formation.

The changes which are responsible for the production of hypoplastic enamel take place in the ameloblasts, as has been shown by Becks,[11] Weinmann,[13, 14] and Kreshover.[16] The earliest evidence of abnormal enamel formation is a change in the ameloblastic cells and is characterized by the accumulation of small irregular masses of deep blue staining matrixlike material in these cells. There is no demonstrable morphologic change in the ameloblasts associated with the retention of matrix material, and the condition, therefore, indicates a probable functional disturbance only. This change can be observed to a slight degree in most stillborn infants and in those infants who die shortly after birth and is perhaps only a minor change which is reversible in character. It may be of some importance in the formation of the neonatal line.

In many jaws, more severe changes can be observed and result in the production of a poorly formed enamel matrix. In this situation the ameloblasts show, in addition to the retention of matrix material, a mild cystic degeneration of the individual cells (Fig. 1). The cell becomes swollen and large vacuoles appear in the cytoplasm. There is also destruction of the nuclear elements. The vacuoles appear first at the basal end of the cell and increase in size until the entire cell is involved (Fig. 2). The edema and vacuolization may involve several cells in one area.

In those areas where several cells are involved, enamel matrix is poorly formed. This inferior formation appears as a rather deep blue staining matrix material which contains many vacuoles filled with a pale pink precipitated tissue fluid that gives a foamy appearance (Fig. 3). The cells surrounding the area of foamy matrix may undergo complete degeneration with the formation of a cystic space. They show proliferation frequently.

In the areas where large numbers of cells are involved severely, there is a localized proliferation of the inner enamel epithelium. The ameloblastic cells in this area proliferate and form large tall columnar cells resembling differentiating ameloblasts. They, however, lack the characteristic orderly arrangement of normal ameloblasts and appear like a group of immature ameloblasts surrounding a space containing globules of enamel matrix (Fig. 4).

Associated with the proliferative activity in the ameloblastic layer is a similar proliferative change in the adjacent stratum intermedium. The cells of the stratum intermedium increase in number and size and are polyhedral

Fig. 1.—Ameloblasts showing hydropic degeneration. Cells are swollen, granular, and vacuolated. Hematoxylin and eosin. ×400.

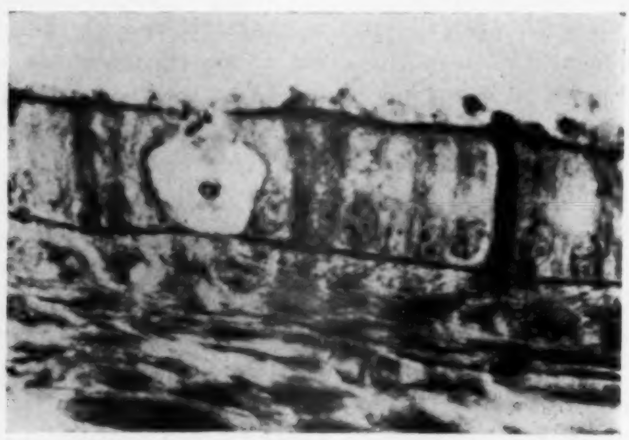

Fig. 2.—Complete cystic degeneration of a few ameloblasts. Vacuolization of neighboring cells. Hematoxylin and eosin. ×400.

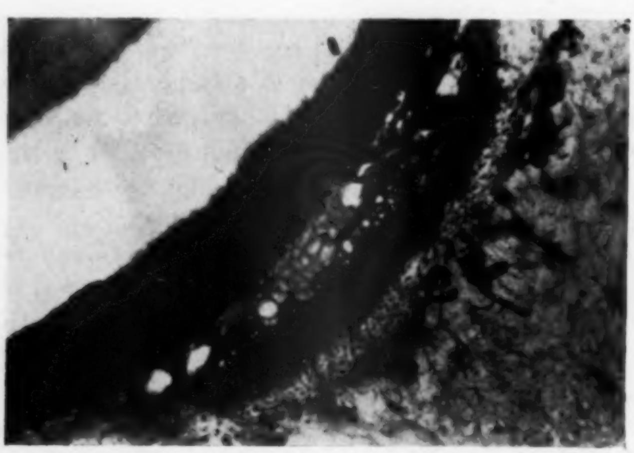

Fig. 3.—Degeneration and proliferation of a portion of the enamel organ. Poorly formed foamy enamel matrix abundant. Hematoxylin and eosin. ×100.

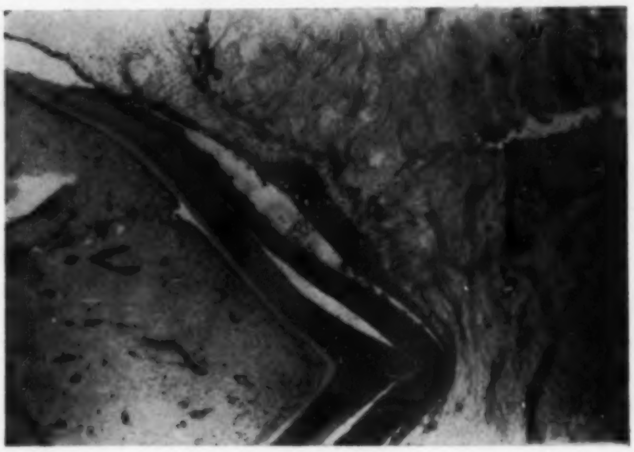

Fig. 4.—Small cystic area in enamel organ containing enamel matrix. Marked proliferation of ameloblastic and stratum intermedium cells. Hematoxylin and eosin. ×40.

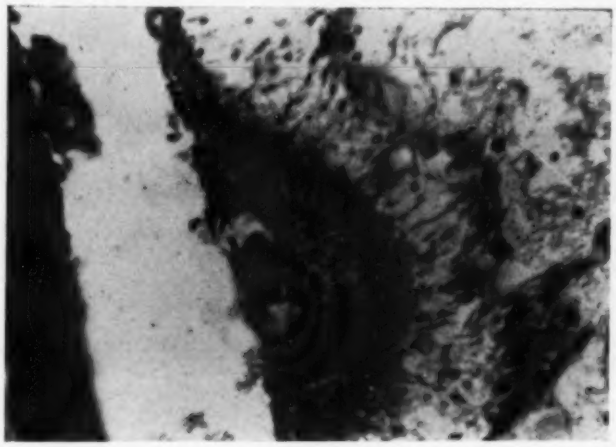

Fig. 5.—Higher magnification of Fig. 4. Hematoxylin and eosin. ×100.

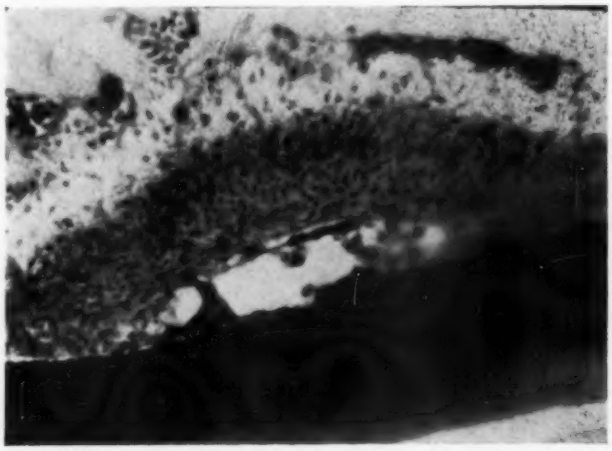

Fig. 6.—Cystic area containing foamy enamel matrix surrounded by zone of proliferation. Hematoxylin and eosin. ×100.

in shape. They produce a layer several cells thick which invades the stellate reticulum. This area of proliferative activity surrounds a space in which is found varying sized masses of poorly formed enamel matrix (Figs. 5 and 6). This area of proliferation appears to be an attempted reparative process.

In some instances the mass of material found within the cystic space is eosinophilic in character (Fig. 7). It appears of the same consistency and stains in the same manner as extracellular epithelial hyaline. It appears to be enamel matrix which is devoid of calcium salts.

In recent papers by Saunders, Nuckolls, and Frisbie,[17] and Orban, Sicher, and Weinmann,[18] it was stated that enamel matrix formation was due to hyalinization of the ameloblasts, and calcium salts were deposited in the matrix during or after its formation. It is possible, however, that matrix formation could take place without having calcium salts deposited in it. In such a condition, we would have a mass of epithelial hyaline as appears in this case.

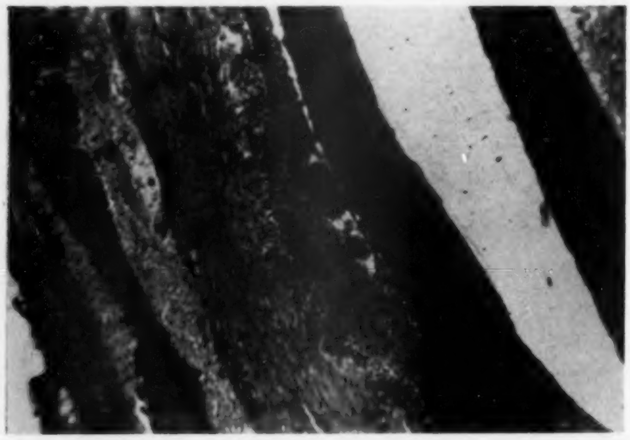

Fig. 7.—Cystic area containing eosinophilic enamel matrix and surrounded by zone of proliferation.

The areas in the ameloblastic layer showing these changes will be represented in the completed enamel as hypoplastic defects. The slight changes in which there is vacuolization of a few ameloblasts, because it is probably reversible, will result in an altered incremental line, while those more severe changes which are not reversible will produce pits and grooves of varying magnitudes, depending upon the severity of the alterations in the enamel-forming epithelium. The number, character, and position of the defects will depend on the severity of the process, the duration of effectiveness of the etiological factor, and the chronological period of its activity.

In this case the etiological factor appears to be one of nutrition rather than of some specific disease process.

SUMMARY

Changes have been described in the enamel organ in the order of their severity, and the lesions produced have been indicated. These changes were confined to the ameloblastic layer, but in severe cases, there was an associated change in the stratum intermedium. They may be submitted as evidence that enamel hypoplasia is essentially a disturbance in the ameloblasts.

Hypoplastic changes may be initiated at any time during enamel formation, and their severity depends on the extent of ameloblastic involvement.

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ACTINOMYCES IN THE NORMAL MOUTH AND IN INFECTIOUS PROCESSES

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EARLY writers on the subject of actinomycosis were of the opinion that the cause of the infection—the ray fungus—was transmitted directly from infected cattle, or indirectly by straws, soil grass, etc., which had been contaminated by cattle. Freed and Light[1] report a case which they felt was due to the fact that the patient, a slaughterhouse worker, drank fresh blood from cattle. This idea is still held by many clinicians who attempt to trace the occupation of the infected person to one having something to do with cattle.

Recently, more careful studies have shown that the disease is not limited to any occupational group, or to rural rather than urban populations. It has also been shown that it is not particular to any age group. Gardiner[2] reports a case of actinomycosis in a 2-year-old child.

The infection in man is caused by *Actinomyces bovis*—a group of fungi having a probable relationship to the acid-fast and diphtheroid groups of bacteria. Wright,[3] in 1905, was one of the first to suggest that the organisms are normal inhabitants of the oral cavity and intestinal tract. He also states that foreign bodies, such as straws, etc., do not serve as carriers of the organisms but rather as transmitting agents so that organisms already present produce the lesions of actinomycosis.

Lord[4] showed that the organisms were present in carious teeth and in tonsils of patients having no indication of mycotic infection. Animals inoculated intraperitoneally developed omentum tremors with the formation of club-like structures resembling actinomyces. Lord did not report the isolation of the organism in pure culture.

Emmons[5, 6] reported the cultivation of *Actinomyces bovis* in pure culture from teeth and tonsils. These organisms were saprophytes and no mycotic infections were present in the cases reported. Sullivan and Goldsworthy,[7] and Slack[8] have also confirmed the fact that the organisms are present as saprophytes in the normal mouth and may invade the tissues when conditions become favorable. Injury is one of the most common predisposing factors and probably explains the cervicofacial actinomycosis which follows tooth extractions, fractures, and blows. Robinson[9] reports a case of actinomycosis of the forearm following a human bite.

The saprophytic organisms have been isolated from root canals in our laboratory.[10] The apical lesions in these cases did not resemble a mycosis. No sulfur granules were found and the organisms on direct smear were shorter

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than those isolated from actinomycosis. When the organisms were cultured, however, they grew as typical *Actinomyces bovis.*

In the infectious process the diagnosis of actinomycosis depends on the presence of sulfur granules in free pus or in the tissue. The infection is characterized by a purulent discharge containing "sulfur granules" and the formation of sinuses and granulation tissue. Usually large amounts of a watery pus may be expressed from the sinuses. The granules may be seen macroscopically and are not always present in large numbers, and sometimes repeated examinations must be made to find the granules. A positive diagnosis, however, depends on the presence of the granules since the pus may show filaments resembling actinomyces but which are not true actinomyces. The granules may be gray, yellow, or brown in color. The sulfur granules are colonies of the fungus, at the periphery of which are radiating clubs surrounded by sheaths which, when stained, take acid rather than basic dyes. The granules when crushed are seen to be made up of extremely fine branching, wavy filaments. When stained by Gram's method, the filaments are gram-positive although gram-negative filaments may be seen. The filaments show true branching.

The organisms are cultured with some difficulty. Most of the strains when first isolated grow best under anaerobic conditions. We have been able to grow the organisms rather easily in beef infusion broth pH 7.4 containing 0.1 per cent agar, 0.2 per cent glucose and 5 per cent ascitic fluid. Many transfers are necessary to insure pure cultures; even then, it is not always possible to eliminate other organisms found in the pus. Wright[3] suggests allowing the granules to dry on the side of a sterile test tube for eighteen to twenty-two days before culturing. The actinomyces will grow in the semisolid media described above as fluffy masses in the bottom of the test tube. Growth may occur in two to three days after incubation at 37.5° C. but it is well to keep cultures two weeks before discarding them as negative. When growth from the semisolid media is plated out on blood agar, the colonies appear in twenty-four to forty-eight hours as small dewlike colonies. After three to four days' incubation, the colonies become tenacious and are firmly imbedded in the media.

A positive laboratory diagnosis consists first in finding the typical granules in the pus or tissue sections. If the granules are found in the pus, they should be crushed and smeared out on glass slides. The presence of wavy branching filaments should be ascertained. It is rarely possible to culture the organisms from pus when no granules can be seen. One method by which the granules may be found more easily is to fix the pus in formalin and make paraffin sections of the material. This method is also satisfactory where laboratory facilities are not available, since the fixed pus may be mailed to a laboratory.

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SURGICAL CORRECTION OF MANDIBULAR PROGNATHISM, AN IMPROVED METHOD

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THE value of surgical interference as an adjunct to successful orthodontic treatment of advanced cases of mesioclusion and distoclusion has been indubitably demonstrated by many able observers. Since the first paper by Blair[1] in 1907 on the subject of surgical correction of malocclusion, numerous reports have appeared in the literature on this subject. Variations in technique have been concerned principally with the site at which the bone was severed. This has varied from section of the condyle neck, horizontal section between the sigmoid notch and the mandibular sulcus, section below the mandibular sulcus, section through the gonial angle, to section through the body of the mandible at various sites. These procedures have been accomplished by open methods permitting direct vision of the operative site, or by closed procedures, as done with a Gigli saw passing around the bone through small openings on either side, not permitting a view of the sectioned bone. The operations have been done both by intraoral and extraoral approach. Approximation of the bone ends has been maintained by direct wiring by some surgeons, by orthodontic appliances by others, and left to chance contact by most.

Despite the brilliant successes reported by many authors, none of the procedures has gained widespread popularity. The possibilities of failure and complication are numerous. No doubt many observers have become discouraged and have abandoned surgical procedures for less effective nonoperative measures. The number of operations performed for correction of these deformities lags far behind the anticipated demand.

Sectioning through the ascending ramus at any level with repositioning interferes with the directional pull of a very well-balanced system of heavy muscles and may lead to malunion, nonunion, or open-bite, any one of which might create a greater deformity than the original. Section below the level of the mandibular sulcus in the ramus is certain to result in sensory paralysis of the bone and teeth on the involved side, and anesthesia of the labial mucosa of the mandible, the lower lip, and the skin of the chin.

Section through the body of the mandible, except as after the method of New and Erich,[2] results in interference with the inferior alveolar nerve, resulting in temporary and often permanent sensory paralysis of the portion of the nerve distal to the operative site.

All of the methods described for sectioning through the body of the bone further offer the disadvantage of compounding the wound intraorally, thereby creating the possibility of delayed union, nonunion, or osteomyelitis. Although infrequent, these complications do occur and should be prevented if possible.

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A two-stage procedure is described in which it is possible to obviate many of the undesirable features of other operations. The procedure consists of removal of a section of bone from the body of the mandible, without cutting the inferior alveolar nerve or compounding the wound intraorally. This is advantageous because the muscles of mastication remain undisturbed, troublesome anesthesia is avoided after the method of New and Erich,[2] and the possibility of infection from oral contamination is eliminated.

The technique described does have the disadvantage of sacrifice of normal tooth structure and bone at the operative site, but this disadvantage becomes minimal in the light of accomplished end results. Another theoretical disadvantage is the disturbance in the temporomandibular joint, incident to the slight medial rotation of condyle head due to shortening of the distance between the molar areas. The distance between the molar areas becomes shorter when the anterior segment is moved posteriorly in contact with the proximal fragments. None of our patients has complained of discomfort in the joint, even after large segments of bone have been removed from the body of the mandible.

By this method the correction of mesioclusion or prognathism may be accomplished in two stages, after removal of the teeth from the operative area.

After carefully considering the local and general situation from all angles as outlined in a previous communication on this subject,[3] the site of operation is selected. The areas of preference are distal to the first premolar because of the technical difficulty involved in avoiding the mental nerve anteriorly. The selection of the site may be influenced by existing edentulous areas in the premolar or molar areas. If an edentulous second premolar area already exists and is wide enough to permit excision of the desired amount of bone, this area should be used. The ideal area is the first molar region, but in some instances, this will not be large enough and must also include the second premolar or the second molar area. The width and shape of the section of bone to be removed can be accurately predetermined by a study of plaster casts, and is dependent upon the degree of prognathism and the degree of opening or closing of the bite necessary to obtain the optimum occlusal relationship.

It is preferable to have sound teeth on both sides of the operative site in order to insure greater stability of the fragments. This is not necessary, however, as one of our cases was sectioned posterior to the first molar on one side and posterior to the second molar on the opposite side, both of which were the last teeth in the arch. Although the proximal segments of bone were edentulous, approximation was maintained adequately by direct wiring and intermaxillary fixation. If teeth are present in the area selected for section of the bone, they are extracted with a minimum of trauma, particular care being taken to retain the buccal and lingual alveolar bone. The areas are permitted to heal over entirely and fill in with new tissue. This takes approximately three months.

The first stage consists of making an incision along the crest of the ridge and gingival margins of the adjacent teeth, stripping the mucoperiosteum from the buccal and lingual surface of the ridge in the immediate vicinity, and cutting the bone. The bone is cut downward and transversely across the

Fig. 1.—Mandible showing approximate depth of cuts at first stage.

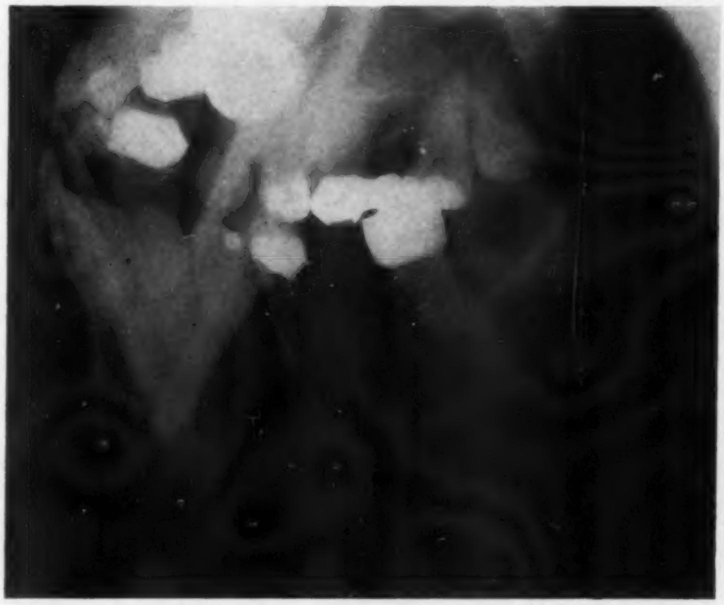

Fig. 2.—X-ray of Case 1, after first stage, showing depth of drill cuts outlining bone to be removed at final stage.

ridge with a small bone drill. A safe distance between the lower end of the bone incision and the nerve is maintained to avoid injury to the inferior alveolar nerve. A block section is thus outlined to accurate measurement, representing the amount of bone ultimately to be removed. The bone is not removed at this time. The soft tissue is returned to position and carefully sutured to place. This stage of the correction may be done under local anesthesia as an outpatient office procedure (Figs. 1 and 2).

The soft tissue is permitted to heal over the ridge in preparation for the final stage. About three weeks is allowed to elapse before undertaking the final step. During this period, the orthodontist is engaged in constructing suitable upper and lower appliances for maintaining the position of the fragments after sectioning. These appliances should be sturdy and are attached to the teeth by bands cemented to all cuspids and available posterior teeth.

The appliance most satisfactory in our hands is the orthodontic type, consisting of a labial buccal arch wire to which short vertical wire projections are welded on the side opposite the occlusal surfaces of the teeth. This arch wire is attached to the teeth by bands and provides an excellent method of maintaining fixation by means of intermaxillary rubber band traction.

The appliance is not attached to the teeth distal to the operative site, but the distal teeth are banded and attachments are provided for anterior rubber band traction in a horizontal plane to aid in maintaining apposition of the fragments.

If immediate postoperative occlusion adequate to maintain the position of the segments is not imminent from a preoperative study of the casts, a simple occlusal acrylic splint is constructed to insure accurate positioning of the segment and to prevent elongation of teeth not in occlusion.[4]

In our experience, it is more satisfactory to resort to an occlusal splint in cases where good immediate postoperative occlusion does not seem to be probable, rather than to submit the patient to preoperative orthodontic treatment. It has been our policy to place the mandible in the optimum position from which orthodontic treatment can be started, by resorting to the use of splints, rather than to submit the patient to a preoperative and postoperative course of orthodontic treatment.

After having constructed the necessary preoperative appliances and having ruled out contraindications to operation, the patient is hospitalized and made ready for surgery. The anesthetic may be local or general, but intratracheal anesthesia via nasal tube is preferable in most instances. Rubber bands placed in the direction favoring positioning after sectioning are applied before operation.

Incisions are made bilaterally along the inferior border of the mandible in the selected area, and the inferior border of the body of the bone is exposed. By retracting the periosteum to the lingual and buccal a slight amount, the cuts in the bone from the previous intraoral stage are readily seen. By use of bone drills, these cuts are extended to the lower border of the bone, avoiding the mandibular nerve which is carefully exposed by excision of the surrounding bone with chisels and rongeurs (Fig. 3). Before complete excision of the bone, holes are drilled with a small bone drill from buccal to lingual, just above the inferior border of the bone on both sides of the osteectomy site.

These provide pathways for passage of 22 gauge stainless steel wire which is used to approximate the bone segments. After excising the bone up to the nerve, it is quite simple to remove the entire block of bone above the nerve without getting into the oral cavity. The medullary portion of the bone is then countersunk to permit approximation of the bone fragments without injury to the nerve. The wires are twisted tightly and cut short (Figs. 4 and 5). It is unnecessary to remove this wire. The wound is dusted with sulfanilamide crystals and closed with a small rubber drain in place. This is removed in twenty-four hours.

Fig. 3.—Represents a section of bone removed from mandible bilaterally, without interference with the inferior alveolar nerve.

New and Erich[2] advise waiting twenty-four hours after surgery before bringing the teeth into occlusion. This period of time permits the patient to completely react from the anesthetic and to recover the protective respiratory reflexes, before crowding a large tongue into a reduced oral space.

This is especially true in cases where there appears to be unusual enlargement of the tongue, with the necessity of removal of a large amount of bone bilaterally. In a large series of patients fixed in occlusion immediately postoperatively, we have had only one case of respiratory embarrassment, and this was anticipated preoperatively. In doubtful instances it would seem judicious to follow the suggestion of New and Erich. In all cases operated under general anesthesia, where fixation is immediate, it is advisable to leave the intratracheal tube in place until the patient completely reacts from the anesthetic, and to refrain from using morphine for the first postoperative day at least. All of these patients should have special nursing service for the first twenty-four-hour postoperative period.

Fig. 4.—This shows approximation of bone fragments and fixation by direct wiring after osteectomy.

Fig. 5.—X-ray of Case 1 postoperatively.

Fig. 6.—Preoperative photograph. Note disharmony of features.
Fig. 7.—Postoperative. Note loss of prominent appearance of chin.

Fig. 8.—Preoperative profile.
Fig. 9.—Postoperative profile eight weeks after operation. Note minimal scar underneath mandibular border.

The period of fixation has averaged eight weeks, after which orthodontic treatment may be started. During the period of fixation, the general and special care given to fracture cases is instituted.

Fig. 10.—Preoperative occlusion.

Fig. 11.—Postoperative occlusion the day intermaxillary fixation was discontinued, eight weeks after operation. Note sturdy orthodontic appliances for intermaxillary rubber band fixation. The mandible is now in position for institution of successful orthodontic treatment.

Case 1.—E. C. (Figs. 6 to 11), 20-year-old white woman. This patient consulted her orthodontist for correction of malocclusion because of embarrassment due to prominence of the mandible. Surgical measures were instituted as an adjunct to orthodontic management.

On Oct. 4, 1943, both lower first molars were extracted with an uneventful postoperative course. Three months later, on Jan. 6, 1944, the intraoral first stage procedure was done (Fig. 2). The soft tissue healed completely and the final stage was done four weeks later under intratracheal nitrous oxide-oxygen-ether anesthesia. Approximately 1 cm. of bone was excised bilaterally from the body of the mandible. There was no postoperative anesthesia of the lower lip, and the postoperative course was entirely uneventful. She was discharged on Feb. 5, 1944, the fourth postoperative day. Although the immediate postoperative occlusion was not ideal, it was the best possible to obtain under the circumstances, and the mandible was in the optimum position for the institution of orthodontic treatment.

Case 2.—One death has occurred in our large series of cases. This is reported because it brings out some pertinent points in the postoperative management of patients operated for correction of prognathism. A 17-year-old girl presented for surgical correction of a moderately pronounced prognathic deformity. Physical examination was negative except for the mandibular deformity and a noticeable enlargement of the tongue. The speech was thick and slightly slurred. Some postoperative difficulty was anticipated. The teeth were placed in occlusion on the table after an operation of somewhat over two hours. Blood loss was minimal and the patient left the operating room in the later part of the morning in good condition and breathing normally through the intratracheal anesthetic tube. Orders were left to have the tube retained until the patient had completedly reacted and to be removed only by a doctor. A suction machine was kept at the bedside for removal of mucus from the nose and throat, and intravenous glucose was administered. At 5:30 P.M., $\frac{1}{6}$ grain of morphine was given by hypodermic for pain and restlessness. I saw the patient at 6:15 P.M. She was awake, was alert, and responded to questioning. The respirations were normal. The tube was removed slowly and there was no respiratory embarrassment. I stayed with the patient for fifteen minutes, until satisfied that there was no respiratory difficulty and left instructions that the patient was not to be left unattended and was to remain in Fowler's position with the head elevated. The patient took a glassful of liquid food by mouth without difficulty about 6:30 P.M. Due to a nursing shortage, no special nurse was obtainable, but the mother of the patient was at the bedside continuously. About 7:15 P.M. the respiration and pulse were checked by the floor duty nurse and no trouble was observed. A minute or two later the mother noticed the patient was perspiring, had unusual pallor, and had ceased breathing. There was no struggle. A nurse and intern immediately entered the room and cut the rubber bands, suctioned the throat, administered artificial respiration, and injected coramine into the heart, but to no avail. The intern could not observe heartbeats even immediately after respirations ceased.

No autopsy was obtained, so the cause of death was not definitely determined. One might suppose, however, that as long as the patient remained awake, she was able to maintain the airway in spite of a crowded oropharyngeal space, after the intratracheal tube was removed. As a result of the administration of morphine, and exhaustion from the day's events, she possibly lapsed into unconsciousness, lost her pharyngeal reflexes, and expired

because of obstruction of the airway by an enlarged tongue. The possibility of a pulmonary embolus must also be considered. In any case of this kind, it would be safer to leave the mouth open, putting the teeth in occlusion only after the patient had completely reacted from the operation.

SUMMARY

The details of a surgical technique are described for the correction of mandibular prognathism by means of sectioning a portion of bone from the body of the mandible, without interference with the inferior alveolar nerve and without compounding the wound intraorally.

CONCLUSIONS

1. No procedure has as yet been described for the correction of mandibular prognathism that does not have some disadvantageous features.

2. The method described in this paper has fewer objectionable features than other procedures and is most likely to give satisfactory final results, with the possibility of fewer complications.

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THE DENTIST'S RESPONSIBILITY IN THE MANAGEMENT OF THE PATIENT WITH RHEUMATIC HEART DISEASE

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PROBABLY there is no type of individual who causes more apprehension or anxiety to the dentist or demands a closer cooperation with the physician than the "cardiac."

From the dental standpoint the judicious treatment of such a patient requires at least certain fundamental knowledge of cardiac disease. It is true, probably, that the dentist often makes no attempt to become informed on the problem of the cardiac patient. Due to lack of interest or ignorance, the patient may be subjected to serious complications. Further, too much reliance often is placed on the decision of the physician, who, although usually fully acquainted with the cardiac status of the patient, does not always know the complete dental portion of the problem. Certainly, the management of this important group of individuals requires that both the medical and the dental profession understand each other's problems.

From the dental standpoint, the adequately informed dentist will possess more composure and self-confidence and a greater acuity in the recognition of cardiac disease. His diagnostic skill and composure, in turn, will promote a more satisfactory and desirable relationship with the physician and assure greater safety to his patient. In addition, he will be better prepared to meet complications when they occur.

Considerable literature concerning this subject has been written by competent medical authorities. Such articles as those published by Reichert,[1] Hyman,[2] Weinstein,[3] Schwartz and Salman,[4] as well as many others, would be well worth the careful perusal of the uninformed dentist.

The present discussion deals specifically with the dentist's responsibility in his management of only one small group of "cardiacs," patients with rheumatic heart disease. It is well known that this particular type of individual is a candidate for the usually fatal disease called subacute bacterial endocarditis. It is by no means a rare or unusual disease. Frequently it follows oral surgical procedures and is caused by the localization of bacteria on previously damaged heart valves, the organisms being liberated into the blood stream as a result of the trauma of surgery.

This information has been available for many years. No treatment, however, other than precautionary measures, has been advocated which would prevent the localization of organisms on damaged heart valves. Recently we[5, 6] have shown that by proper prophylactic sulfonamide therapy the incidence of bacteremias following the extraction of teeth could be markedly

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decreased. Although this material has been published, the subject and the added responsibility to the dental profession are thought to be of sufficient importance to warrant republication in order to reach a still larger group of dental practitioners. This discussion will be presented with the thought in mind of giving only basic information necessary to understand the problem, omitting much of the scientific detail discussed in previous reports.[5, 6]

Since the early studies of Richards,[7, 8] it has been shown many times by investigators in various fields of medicine and dentistry that, as a result of manipulation or trauma, showers of organisms are carried into the blood stream. Such a bacteremia is transient, the organisms remaining in the blood stream only for about three to five minutes, after which time they disappear.

Dentistry first was introduced to the problem as a result of the spectacular findings of Okell and Elliot,[9] who showed that transient bacteremias followed the extraction of teeth. These investigators were interested primarily in the source of the *Streptococcus viridans* found on the vegetations of those hearts which exhibited subacute bacterial endocarditis. In their study of 138 cases, blood cultures were made before and immediately following the extraction of teeth. The surgery was performed under general anesthesia. Of the entire group, a transient bacteremia occurred in 64 per cent of the cases. The patients were placed in three classes, their classification depending on the degree of oral sepsis present. In the severely septic and pyorrheic mouths, a bacteremia was found to follow surgical operations in 75 per cent of cases. Even in 38 cases without recognizable oral sepsis, 12 patients, or 31.5 per cent, had positive blood cultures. Of the entire group, positive blood cultures were obtained preoperatively in 12 instances, or 8.6 per cent. Except on four occasions the organism isolated was *Streptococcus viridans.*

Elliot[10] later has shown that where marked gingival disease was present, the mere rocking of the tooth was sufficient to permit the organisms to enter the blood stream.

Murray and Moosnick[11] have shown that transient bacteremia follows the chewing of paraffin blocks.

In the past few years, several well-conducted investigations have been made wherein blood cultures have been taken immediately following the extraction of teeth.[5, 6, 12, 13] The incidence of transient bacteremias, under these conditions has been found to be about 17 per cent. The wide variation of the incidence under local and general anesthesia can be attributed to the vasoconstrictor action of the adrenalin incorporated in most local anesthetics.

SIGNIFICANCE OF TRANSIENT BACTEREMIAS

With the fact now in mind that bacteremias do occur, the problem presents itself, "What is the significance of these bacteremias?"

In the normal individual a bacteremia is probably of little or no significance, since the blood stream quickly destroys the newly introduced organisms. It might be added, however, if there is any basis for the theory of focal infection, surely the frequent introduction of bacteria into the blood stream, even in a normal individual, must be considered as a portal of entry for pathogenic organisms.

Streptococcus viridans, a common inhabitant of the gastrointestinal tract, is the most common organism in the oral cavity. It is also the organism most fre-

quently found in the blood stream during transient bacteremia. Since subacute bacterial endocarditis is, in most instances, the result of localization of *Streptococcus viridans* on previously damaged heart valves, it becomes apparent that such a bacteremia may be of grave significance in the etiology of this usually fatal disease.

SUBACUTE BACTERIAL ENDOCARDITIS

Incidence.—This disease is much more frequent in its occurrence than commonly thought. In the average hospital of 200 beds, several cases are treated per annum. This incidence is much higher in areas where rheumatic fever is common. In our University Hospital, six patients with the disease have been known to be hospitalized at the same time. Frequently, the disease is not recognized by the attending physician, probably because of the lack of facilities for clinical bacteriology in many communities.

Subacute bacterial endocarditis is characterized by the formation of vegetations on the heart valves, which are nearly always due to *Streptococcus viridans* organism. Although it is usually due to *Streptococcus viridans*, Galbreath and Hull,[14] in a report of 32 cases, have shown that almost half were due to other organisms. It is thought that in the mechanical function of the heart with valvular disease the valves are readily traumatized. Minute blood platelets form at this site for the colonization of the bacteria. It is understandable that conditions would necessarily have to be ideal before a subacute bacterial endocarditis could develop; that is, a blood thrombus would have to be present on the endocardium at the same time that a bacteremia existed.

This disease has been regarded by most physicians as usually fatal, although undoubtedly some mild and a few severe cases occasionally recover. Recently, treatment by chemotherapeutic agents and heparin have been used with poor results.[15, 16] The work of Loewe, Rosenblatt, Greene, and Russell,[17] in which they report the successful treatment of seven consecutive cases of subacute bacterial endocarditis with the use of penicillin and heparin therapy, is most interesting, and this treatment may have some promise. At present, however, the prognosis for subacute bacterial endocarditis is extremely grave. It is very questionable, once the disease has developed, if any treatment is of value.

According to Katz and Elek,[16] the cause for the persistence of the disease, and the great, if not impossible, difficulty in treating the infection of *Streptococcus viridans* in a valvular vegetation once it has developed, are due to three factors: (a) the relative avascularity of the valve leaflets, (b) the presence of a film platelet barrier which interferes with the entrance of white blood cells and hinders the diffusion into the lesion of the bacteriostatic and bactericidal agents present in the blood stream, and (c) the fibrin constantly being added, which offers an excellent medium for the growth of these bacteria.

Symptoms.—As a rule, the onset is indefinite. The patient's attention is not directed toward the heart but, rather, he becomes aware of fever and the feeling of not being well. Often where infection of the throat or upper respiratory passages is present, or where recent surgery has been performed, such as a tonsillectomy or the extraction of teeth, the patient feels that he simply has failed to recover. The fever is remittent in character, with daily peaks of 102° F. being common.

The vegetations on the valves or on the walls constantly supply the blood stream with organisms which frequently produce emboli.

As the disease continues, the symptoms become more definite and diagnosis is easier. The patient develops a progressive anemia as well as embolic phenomena. The latter consist of petechial hemorrhages on the skin or under the nails. Emboli may settle in various organs such as the kidneys, an albuminuria and transient hematuria resulting. The patient may live six months or a year although frequently death may occur in a few weeks or months. Most commonly, death is due to the complete exhaustion of the patient.

It is true that subacute bacterial endocarditis affects people who have damaged heart valves, usually as a result of rheumatic fever. Rheumatic fever, however, is not the only source, for subacute bacterial endocarditis may occur with congenital heart disease. One-third of those with this disease die from it.[18] It also may complicate sclerosed valves due to arteriosclerosis, or the aortic valve in syphilis.

These latter conditions are not discussed here in any detail. It should be kept in mind, however, that individuals with congenital heart disease, arteriosclerosis, or syphilitic involvement of the endocardium should be treated in the same manner as the patient with rheumatic heart disease.

RHEUMATIC HEART DISEASE

"Rheumatic heart disease" is a condition of progressive and permanent structural changes in the heart as a result of rheumatic fever.

RHEUMATIC FEVER

In rheumatic fever, the probable cause, according to current opinion, is thought to be infectious, and apparently closely associated with the invasion of the body by hemolytic streptococci. It is characterized primarily by fever, toxicity, polyarthritis, and disseminated focal inflammatory lesions of the cardiovascular system. It might be stated here that chorea, often known as Saint Vitus's dance, is now considered as a part of a multiple symptom complex; in other words, chorea is rheumatic fever plus a further complication or involvement of the brain. In addition to the usual symptoms accompanying rheumatic fever, these patients have marked psychic changes, involuntary muscular twitchings, and a propensity to endocarditis.

Incidence.—Rheumatic fever is a common disease. Paul[19] has estimated a total of 840,000 cases of rheumatic heart disease, active and inactive, in a population of 100,000,000 people. Since nearly all cases of rheumatic fever leave some degree of endocarditis or scarring on the heart valves, it becomes evident that about 1 in every 100 patients entering the dentist's office, based on Paul's figures, is a candidate for subacute bacterial endocarditis. This incidence will be much higher in certain communities, for the disease is more prevalent in damp areas such as those near water fronts. It also occurs more frequently among the poor and undernourished. Children are particularly susceptible to this disease, since over 70 per cent of the cases occur between 4 and 30 years of age, the peak being between 7 and 10 years.[20]

Briefly, the disease affects the myocardium, pericardium, and, especially, the endocardium in which granulomatous formations occur. The pathologic picture

and the amount of injury produced depend on the location, size, and stage of their development. These granulomatous formations commonly are called vegetations. Those vegetations which occur so frequently along the heart valves result in scar formation later when healing takes place. These areas are the sites where the bacteria localize and produce a subacute bacterial endocarditis.

PROPHYLACTIC USES OF SULFATHIAZOLE

It was with this information in mind that our study was made in the hope that by premedication with sulfathiazole the incidence of bacteremia following oral surgical procedures could be decreased. If a decreased incidence could be shown, then it would be reasonable to assume that prophylactic sulfonamide therapy would be indicated for those people with pre-existing valvular heart disease when surgery is contemplated. Further, such a procedure should decrease the possibility of the development of a subacute bacterial endocarditis. We were aware that the nonhemolytic streptococci, that is, *Streptococcus anhemolyticus* and *Streptococcus viridans,* had been thought to be unaffected by the bacteriostatic action of the sulfonamides. Nevertheless, it was our hope that such prophylactic treatment might still be efficacious. No attempt was made to select any specific type of case or even to limit the number of extractions to one or two teeth. All types of extractions were included in the series. The surgical procedures were carried out by students, using 2 per cent procaine with 1:50,000 adrenalin. The bacteriologic techniques will not be given in this article but can be obtained in the original report.

In the beginning of the study, 1 Gm. of sulfathiazole and a like amount of sodium bicarbonate were given every four hours until 6 Gm. of the drug had been taken by the patient, the last dose having been given three hours before the operation was performed. In all of these studies, blood cultures and blood levels were taken just before the local anesthetic was administered. Blood cultures were then taken immediately following surgery, and again ten minutes later.

In this group (95 cases), it was found that only 40 had a blood level over 4 mg. per 100 c.c., while 55 cases fell below that level. It is to be remembered that it is desirable, in order to have an optimum bacteriostatic action of sulfathiazole, to have a blood saturation of over 4 mg. per cent. Where the blood level was above 4 mg., the incidence of positive blood cultures was found to be 5 per cent, whereas in those cases where the blood level was below 4 mg., the incidence was 14.5 per cent, nearly approximating the usual unpremedicated case of 17 per cent.

These findings revealed the importance of raising the blood level of the drug above 4 mg. if the optimum results are to be obtained. It also showed the difficulty in raising and maintaining an adequate blood level above 4 mg. per 100 c.c. The variation of the blood level probably was due to the individual ability of the patients to absorb and secrete the drug and to the failure on the part of the ambulatory patient to cooperate by taking the drug every four hours, especially at night.

In this entire series and also in nearly 100 cases used as a control series, positive blood cultures were not obtained either before or ten minutes following surgery. It seemed evident that it was only necessary to have a maximum blood level at the time of the operative procedure. Also, with the discouraging results

in mind when using the routine procedure, it was decided to give one massive dose of 5 Gm. each of sulfathiazole and sodium bicarbonate three hours before surgery.

Forty-four cases were studied in this group. Thirty-one of the total showed blood levels of over 4 mg. per cent, the average being 5.8 mg. An incidence of 3.2 per cent of positive cultures was found in this group. The remaining 13 patients in whom the blood level was found to be below 4 mg. per cent, with an average of 3.4 mg., showed an incidence of 0.8 per cent positive cultures, which, considering the size of the group, has little significance.

A composite of these two groups treated by sulfathiazole shows definitely that the blood level of the drug is an important factor in decreasing the incidence of bacteremia. Seventy-one cases in which the blood level was above 4 mg. per 100 c.c. showed an incidence of 4.2 per cent of positive cultures; patients whose blood level was below 4 mg. had an incidence of 14 per cent positive blood cultures.

In this same study a series of 45 cases was studied, using sulfamerazine as the bacteriostatic agent. We became interested in the possibilities of this drug since it has been thought to be less toxic than sulfathiazole and to be absorbed rapidly and excreted slowly, as recently reported by Hall and Spink.[21] This action would be of great advantage since a smaller amount of the drug would be necessary to reach and maintain the desired blood level.

The results from this group of cases were discouraging. Thirty-nine cases in which the blood levels were above 4 mg. per cent, with a high average of 8.2 mg., showed six positive cultures or an incidence of 15.3 per cent. No positive cultures were found in the six cases where the blood level was below 4 mg. per cent. This group again is too small to draw many conclusions; although this study using sulfamerazine as a prophylactic agent is small, it indicates that sulfamerazine is not a good bacteriostatic agent in infections by *Streptococcus viridans.*

COMMENTS

From the results which have been given, it seems that the prophylactic use of sulfathiazole should be instituted in the patient having valvular heart disease when infection is present or surgical measures are contemplated.

Sulfanilamide, sulfapyridine, sulfadiazine, and other sulfonamides may be as effective as sulfathiazole or more so. At the moment, however, there is not sufficient scientific information regarding their merits for prophylactic use with patients who have valvular heart disease. It is our desire to study the effect of penicillin in the same manner as we have investigated the prophylactic use of sulfathiazole. If penicillin should be found to decrease the incidence of bacteremias, it would readily replace sulfonamide therapy, primarily because of its lack of toxicity.

It should be emphasized that sulfathiazole should not be used promiscuously and that its use is advocated for patients whose histories show a predisposition to endocarditis. At the present time, the sulfonamides are being used indiscriminately for many minor ailments, such as upper respiratory infections and sinusitis, and even before the extraction of carious teeth. Such use of these drugs is condemned. Not only is such indiscriminate use of doubtful

therapeutic value, but it is also extremely dangerous to the patient should an idiosyncrasy develop. Furthermore, when an idiosyncrasy develops, the patient is denied the advantages of the drug later when a serious illness occurs.

Medical men whom we have consulted during the past four years have accepted our findings enthusiastically as a contribution to the management of the patient with endocarditis. Not only has the physician cooperated in the medication of these patients, but he also has the opinion that such patients should be given postmedication for at least twenty-four to thirty-six hours, in order to maintain the drug in the blood stream at the proper level. Such treatment probably is the safest procedure.

Although in this study we have not encountered any drug reactions, it is suggested that a physician prescribe the drug, for, on rare occasions, a patient may show an idiosyncrasy to even a small dose or a single dose. Should such a complication arise, the physician not only can share in the responsibility, but also is better able to treat the situation.

In the management of the endocarditis case given premedication, the question arises: How much surgical work should be performed at one time? It is our opinion that, once there is adequate premedication, as much surgical work should be completed at one time as is possible. Of course, such factors as the general health of the individual, the difficulty and extent of the operation, and the degree of the infection, influence this decision. We should keep in mind constantly that a sulfonamide should be used the least possible number of times.

A word might be added here about the importance of the elimination of all questionable foci of infection in this type of patient. Subacute bacterial endocarditis may follow a severe upper respiratory infection, in fact any acute infection or injury. Therefore, the physician and dentist should eliminate any questionable foci so that an acute complication will not arise later and thus predispose this patient to subacute bacterial endocarditis.

As was stated in the previous publication, it is the responsibility of the dentist and physician to afford added safety to patients who have valvular heart disease, by the prophylactic use of the sulfonamides. The dentist should inquire routinely into the patient's past history to determine whether the patient has ever had rheumatic fever, chorea, or any heart disturbance. This inquiry should be made of patients with severe oral sepsis or when surgical procedures are contemplated. If, from this inquiry, possible or definite information suggesting valvular heart disease is obtained, the dentist should contact the patient's physician requesting his confirmation or diagnosis. If his examination suggests the mere possibility of valvular heart disease, sulfonamide premedication should be prescribed. The physician likewise has a responsibility in the management of the patient with congenital heart disease, or endocarditis. Once a physician has under his care a patient presenting a questionable or recognized valvular heart disease, the patient should be considered definitely in the need of prophylactic treatment when any type of surgical operation becomes necessary.

SUMMARY

The management of the "cardiac" requires certain fundamental knowledge and the need for closer cooperation between the physician and dentist.

This discussion limits consideration specifically to the management of the patient with rheumatic heart disease.

Bacteremias have been shown frequently to follow manipulation and trauma of surgical procedures, especially following the extraction of teeth. From such a bacteremia the patient with valvular heart disease (usually resulting from rheumatic fever) may develop subacute bacterial endocarditis as a result of the localization of bacteria on previously damaged heart valves.

The prophylactic use of sulfathiazole, if given in doses sufficient to raise the blood levels above 4 mg. per 100 c.c., reduces markedly the incidence of positive blood cultures.

It is in a large part the dentist's responsibility to manage the patient with valvular heart disease by treatment with sulfonamides.

It is thought that prophylactic premedication with sulfathiazole may prevent the individual with valvular heart disease from developing a subacute bacterial endocarditis.

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INTRACRANIAL LESIONS RESULTING FROM DENTAL INFECTION

Report of Two Cases

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THERE are few reported cases of death due to intracranial lesions resulting from primary dental infection. The following is a report of two cases seen recently at University Hospital; in one death was due to direct extension of the infection, and the other apparently spread by way of the blood stream.

Direct extension would seem rare indeed because of natural barriers, that is, the skull and dura; however, this was demonstrated in one case following masticator space abscess. It would be reasonable to expect sepsis and hematogenous spread to be a more common sequela rather than direct extension for anatomical reasons alone. This again would depend upon the fascial planes involved and the original site of infection.

Case 1.—V. B., a 26-year-old white woman, was brought to the hospital in a semicomatose condition complaining of a swollen jaw and headache. She was apparently well until four weeks previously when the maxillary left third molar was removed under local anesthesia. Four days following this procedure, trismus, swelling, and pain developed over the left ramus of the mandible. Several days later she was hospitalized, and intraoral incision liberated frank pus from the left pterygopalatine fossa. There was gradual improvement for one week and then pain, swelling, and trismus recurred in the same area. The patient again underwent operation, consisting of incision and drainage extraorally at the angle of the mandible. For two weeks prior to admission to this hospital she was slightly disoriented, with some dysphagia, occasional nausea and vomiting, projectile in type. There had also been some complaint of frontal headache; however, there was no evidence of motor or sensory impairment.

On admission the patient appeared acutely ill, semicomatose, and responded only to rather vigorous stimuli. There was slight swelling over the left ramus of the mandible extending into the temporal area. Through the incision at the angle of the mandible there was a slight amount of seropurulent drainage. Intraorally there was no evidence of pathology. The site of the recent extraction had healed completely. Except for slight mental confusion the remainder of the physical examination was negative.

The patient was operated on the day of admission. Frank pus was found under the temporal muscle. It was also found that this communicated directly with the incision at the angle of the mandible through a sinus tract beneath the zygoma. Culture later showed the organism present to be *Streptococcus viridans*.

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The patient was then transferred to the Department of Neurosurgery. The skull was trephined and thorotrast injected beneath the dura. X-rays revealed a brain abscess in the left temporal lobe directly beneath the site of the subtemporal abscess.

The patient was again operated on and the brain abscess evacuated of 20 c.c. of free pus. The postoperative course was not satisfactory and the patient's condition grew steadily worse in spite of the administration of penicillin, and transfusions of whole blood. Forty-eight hours following the operation, the patient expired.

Autopsy confirmed the clinical findings of direct extension of the infection from the subtemporal abscess through the temporal bone to the brain. Culture of the brain abscess again showed *Streptococcus viridans,* the same organism demonstrated in the masticator space abscess.

CASE 2.—C. D., a 55-year-old white man, was admitted to University Hospital complaining of an "infected jaw" and severe pain radiating down the back of the neck. History revealed an abscess of the mandibular left second molar, which had been incised and drained by his local dentist with immediate relief of symptoms. After an interval of two weeks there was sudden onset of pain and swelling over the left ramus. He was hospitalized, and intra- and extraoral incisions were made without liberating any pus. Somewhat improved, he was discharged two weeks previous to his admission to this hospital. After several days he noted pain in the occiput that radiated down the neck. This increased in severity up to the time he was first examined here.

Examination revealed a well-developed, well-nourished man of 55 years in acute distress and somewhat slightly confused.

There was a slight diffuse, firm, painless swelling over the left ramus of the mandible. The pupil of the left eye appeared fixed and there was bilateral palsy of the sixth cranial nerve. There were no other neurological signs. The temperature on admission was 104° F., the white blood count 10,000, and the urine showed a 2 plus albumin; however, the sediment was negative.

Examination of the oral cavity revealed a moderate amount of trismus. The remaining teeth were in a very poor state of repair with far-advanced caries and gross oral sepsis. There was no evidence of any acute process in the oral cavity. X-rays of the mandible revealed several apical abscesses including the mandibular left second molar but no evidence of any other bony pathology.

The patient was placed on 15,000 units of penicillin every four hours and the temperature dropped somewhat but fluctuated between normal and 102° F. for several days. Meanwhile he developed increasing signs of meningeal irritation, and he was transferred to the Department of Neurosurgery for treatment. In addition to the bilateral sixth nerve palsy the patient developed a positive Kernig's sign and stiff neck. All deep reflexes were exaggerated but equal. X-rays of the skull revealed slight cloudings of the basilar bone which possibly indicated some inflammatory process. Lumbar puncture revealed 315 cells, 88 per cent of which were lymphocytes and 12 per cent leukocytes. Pandy's test was positive and the initial fluid pressure 180 mm. Blood and spinal fluid cultures were negative.

In view of the spinal fluid and neurological findings the skull was trephined and ventriculograms made. The brain appeared normal and no pathology was found. The ventricles appeared in normal position.

Temporarily the patient appeared improved. However, the day following surgery he developed a left-sided hemiplegia, and in spite of all supportive measures respiration ceased.

Unfortunately, autopsy was not permitted and the clinical diagnosis of basilar meningitis and questionable basilar osteomyelitis was not substantiated. However, the clinical picture was quite definite.

COMMENT

Even though the above sequelae are fortunately rare, early and adequate treatment is indicated no matter how insignificant the primary dental infection may seem. It is well known that organisms commonly found in the mouth are extremely pathogenic should they invade the cranial cavity. Occasionally, serious sequelae may result even with early diagnosis and proper therapuetic treatment. This may be influenced by uncontrollable factors, such as individual resistance and the type and virulence of the invading organisms.

The purpose of reporting these two cases is to stress the possible dangers of primary dental infection and the importance of early and adequate treatment.

METASTATIC OSTEOCHONDROMA OF MAXILLA FROM PRIMARY TUMOR OF TIBIA

Report of Case

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SARCOMAS are malignant neoplasms of connective tissue origin. They may be so-called pure, that is, connective tissue growths resembling an adult structure, or a considerable degree of differentiation may be present with intercellular substance that is clearly fascia, cartilage, bone, etc. Descriptive terms, such as fibrosarcoma, chondrosarcoma, osteosarcoma (or osteogenic sarcoma), have therefore come into being. The existence of more than one parent tissue in these tumors is depicted by terms such as osteochondrosarcoma.

Osteogenic sarcoma is considered to be one of the most common of malignant bone tumors. It is also regarded as one of the most malignant and incurable of all growths. It is seen more frequently in children and young adults, becoming increasingly rare in middle life. A clinical history of trauma is not uncommon, followed by the appearance of a sharply demarcated, painful swelling at the site of the injury. It usually occurs at the end of the shaft of the long bones, principally in the region of the knee. It occasionally occurs as a primary lesion in the jawbones.

Early rapid growth is marked by discomfort and often an elevated temperature mimicking the picture of acute infection. The prognosis in almost all osteogenic sarcomas is very grave, and the younger the patient the worse the outlook and the more rapid the course.

The tumor grows expansively, but also infiltrates adjacent tissue, the cells creeping along fascial planes, between muscle fibers, and through Haversian canals, thus making successful surgical attempts unlikely and recurrence and metastasis common. It forms a bulky, highly vascular mass with vessels that are young and thin-walled, so that invasion by tumor cells takes place readily and metastasis occurs early by the hematogenous route—notably to the lungs. Indeed, the lungs may well be invaded before a diagnosis of the primary tumor can be made, and radiographic examination of the lungs should be made for metastasis in all cases before surgical treatment is considered. Should tumor emboli pass through the pulmonary capillaries, they may lodge in any organ; however, metastasis of osteogenic sarcoma to other bones is rather rare.

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CASE REPORT

History.—T. A., No. 455150, a 13-year-old white girl, was first admitted to the Bone and Joint Service of the University Hospital, in January, 1940. Approximately five months prior to this date she had tripped and fallen on the right knee. The abrasions healed rapidly, but two months later she noticed pain in the area sufficient to interfere with function. Swelling followed shortly, and the signs and symptoms gradually increased in severity. Her past and familial history were entirely irrelevant and noncontributory.

Physical Examination.—The patient was a well-developed, well-nourished white girl, appearing chronically ill. Examination of the extremities revealed some stiffening of the right knee with a tender, inflammatory swelling about the joint. The temperature was 99.2° F. Further careful and detailed physical examination and laboratory studies failed to reveal any other significant findings.

Radiographic Examination.—Examination of both upper tibiae revealed a marked bone sclerosis of the proximal portion of the right tibial shaft. The radiologists considered the possibility of a sclerosing osteomyelitis, but regarded the probability of a primary bone tumor. Routine radiographic examination of the chest was entirely negative.

Course.—As a definite diagnosis could not be established by the usual clinical and radiographic methods, the lesion was biopsied. A diagnosis of spindle-cell osteochondrosarcoma was returned and, in view of lack of evidence of metastases, amputation was recommended. Accordingly, the right leg was removed by the orthopedic surgeons at the junction of the middle and lower thirds of the femur. Convalescence was uneventful and the wound healed without complication. The patient was discharged on the twenty-third postoperative day with instructions to return for postoperative examinations.

Subsequent Course.—For a period of almost two years after hospital discharge the patient was entirely well. Periodic examinations were negative for recurrence or metastases. In March, 1942, she again returned to the hospital, stating that a few months previous there had been an insidious onset of pain over the lateral aspect of the left femoral condyle, with the complaint that the pain had gradually increased in severity, and recently there had been swelling in this region.

Examination revealed a firm, smooth, symmetrical tumor approximately 6 by 7.5 cm. in size, situated just above the left lateral femoral condyle. Further routine examination and accumulated laboratory data were essentially normal. Chest films remained negative. A biopsy of the left leg tumor disclosed an osteochondrosarcoma of the same general type as that of the primary neoplasm, but less differentiated. During this admission a left mid-thigh amputation was performed. The immediate, as well as the complete, postoperative course was uneventful.

In August, 1942, five months after the last discharge date, the patient noted pain and slight swelling in the left maxillary mucobuccal fornix. Her local dentist found the maxillary left first and second molars to be tender to

percussion and moderately mobile, and removed these teeth. Temporary relief was obtained, but two weeks later a definite mass was visible at the recent operative site.

One month after the extractions the patient was seen in the Department of Oral Surgery of the University Hospital. Examination revealed marked facial asymmetry with definite prominence over the left cheek. A firm, nonfluctuant, tender mass could be readily outlined over the left alveolar ridge and anterior wall of the antrum. Intraorally, a fleshy tumor extended to the mesial aspect of the first premolar and posteriorly to the maxillary tuberosity. The adjacent dentition was partially covered, the mucobuccal fornix obliterated, and the palatal mucoperiosteum expanded toward the midline. A large, firm abdominal mass in the right upper quadrant was considered to be due to liver metastases.

Radiographic examination of the paranasal sinuses demonstrated an extensive neoplasm involving the left maxillary and ethmoid sinuses, left alveolar ridge, and soft tissues of the left cheek. There was also radiographic evidence of recurrent neoplasm at the distal end of the left femur. A scout film of the abdomen showed intra-abdominal calcification, and metastases of the osteochondrosarcoma were considered a likelihood.

By biopsy the intraoral mass was found to be identical with that of the previously occurring tumors of the extremities.

Fig. 1.—Metastatic osteochondroma of maxilla one month following extraction of teeth.

Because of the extensive invasion and unquestioned widespread metastases, therapeutic measures were necessarily confined to symptomatic treatment. An attempt to reduce the size of the maxillary mass by radiation therapy failed, and it was decided that surgical intervention to facilitate mastication and promote a feeling of well-being was in order. Under avertin anesthesia the oral portion of the mass was excised by cautery.

A relatively short period of relief was followed by progressive growth, and in January, 1943, the patient was again admitted for a second partial cautery excision of the maxillary neoplasm. At this time she complained of nasal ob-

struction, slight blurring of vision, radiating pain over the left shoulder, and nausea and vomiting. Narcotics and barbiturates, in restricted dosage, were now required for sedation and analgesia.

After one month the mass had returned to and exceeded its former size, and now was soft, friable, with marked hemorrhagic tendencies. The abdominal mass filled the entire right upper quadrant, and a left radial nerve palsy had developed. A third electrocauterization of the oral tumor was performed, and at the same time the left external carotid artery was ligated as a prophylactic precaution. This procedure was carried out under pentothal sodium anesthesia.

On March 6, 1943, T. A. was admitted to the hospital purely as a nursing problem. The intraoral tumor practically occupied the left half of the oral cavity. There was ptosis of the left lid, left exophthalmos and diplopia on attempting vision beyond 45 degrees from the straight anterior. Respirations were purely diaphragmatic, and a dyspnea with slight cyanosis was present. During this period her temperature remained on a plateau between 103° and 104 F. Routine sodium phenobarbital alternating with narcotics, administered hypodermically, maintained hypnosis with relative comfort.

Cheyne-Stokes type of respiratory rhythm was noted on April 1, 1943, and on April 5, almost four years after initial onset of the disease process and eight months following the dental extractions, respiration ceased.

On post-mortem examination, the huge mass in the right upper quadrant of the abdomen was found to be retroperitoneal metastases, pressing upon the right kidney and adrenal gland. An intact liver was flattened anteromedially to this mass. Other pathologic findings included metastatis to the sternum and substernal tissues, organizing obturating thrombi in the external iliac veins, terminal acute purulent bronchitis, acute edema of the lungs, patchy atelectasis and emphysema, mild chronic cystitis and urethritis, and generalized simple atrophy.

Microscopic Examination.—Microscopic examination revealed the additional positive metastatic findings: a mass of metastatic poorly differentiated chondrosarcoma, with diffuse infiltration of muscle and fascia of the neck; a large retroperitoneal mass of chrondrosarcoma showing a higher level of differentiation than that in maxilla and neck; an extensively infiltrated right kidney by chondrosarcoma which formed an abundant hyaline matrix, and the undersurface of the manubrium covered by a layer of osteochondroma.

COMMENT

Although skeletal metastasis of malignant tumors is not uncommon, metastasis to the jawbones is relatively rare. Carcinomatous metastasis to the jaws from primary lesions in the prostate, breast, thyroid, kidneys, rectum, bronchi, ovary, and parotid gland have been reported. We know of no other reported case of metastasis of osteogenic sarcoma to the maxilla.

The spread of sarcoma to distant parts of the body is usually by way of the blood stream, and the secondary tumors are usually first found in the lungs. Since the lung was not invaded in this case, it can be assumed that it was not

favorable soil for propagation of the neoplastic cells and they presumably passed directly through the pulmonary capillaries without being screened out.

Rapid growth of malignant humors of the jaws following the extraction of teeth is commonly encountered as in this case. Loose teeth associated in a noninflammatory swelling should always suggest the possibility of a neoplasm. Although the tumor of the maxilla no doubt existed and was perhaps far advanced before the removal of the teeth, its growth no doubt was activated by the extraction and added to the discomfort of the patient during the terminal stage.

ADAMANTO-ODONTOMA

Report of Case

John W. Kemper, D.D.S., M.D.,* and R. W. Root, A.B., D.D.S.†

E. W. (No. 552359), a white girl 6 years of age, was admitted to the Oral Surgery Department of the University Hospital with a chief complaint of swelling of the right side of the face. It was first noticed by her mother nine months previous to admission to the hospital. There was a gradual increase in size for about four months, after which the mother stated it seemed to decrease in size. During the past three months there had been no apparent change in size. There had been no symptoms other than the swelling.

The family, birth, and developmental histories were negative. There had been no previous diseases.

Fig. 1.—Photograph showing facial asymmetry caused by maxillary adamanto-odontoma.

Physical examination revealed a well-developed, well-nourished child with an obvious swelling on the right side of the face. The tumescence extended from inferior border of the orbit to the mid-portion of the cheek (Fig. 1). It was noninflammatory, stony hard and painless. It seemingly involved the whole right maxilla. Intraoral examination showed a hard, noninflammatory tumor of the maxilla extending from cuspid region posteriorly beyond the

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Fig. 2.—Intraoral photograph of maxillary adamanto-odontoma.

Fig. 3.—Lateral view radiograph showing large maxillary tumor containing calcified structures and the crowns of unerupted premolars and first and second molars.

tuberosity. The expanded buccal plate of bone completely obliterated the canine fossa and upper mucobuccal fornix. There was bulging of the palatal process extending to the midline of the palate. The two maxillary incisors were missing and the right second deciduous molar was very mobile. The mass was bony hard in its entirety and was painless, with no evidence of suppuration (Fig. 2).

Fig. 4.—Posteroanterior radiograph showing relative size of the tumor and expanded superior and lateral walls of the antrum.

The remainder of the physical examination was entirely negative.

Blood examination showed the hemoglobin to be 84 per cent and the white count 6,300. The Kahn test was negative. The urine was negative, except

Figs. 5 and 6.—Same views as Figs. 3 and 4 after enucleation of the tumor.

for 8 W.B.C. per high-power field. The tuberculin test was negative as was the admission chest film.

X-ray examination of the skull revealed a large tumor filling and expanding the right maxillary antrum to considerable proportions. The growth showed extensive patchy calcification with several crowns, perhaps of the second dentition, in the premolar and molar regions (Figs. 3 and 4). There was no evidence of invasion of the ballooned-out orbital, medial, and lateral walls.

Since there was so much expansion of the superior and lateral walls of the antrum without any apparent erosion, it led to the impression that this was most likely a benign lesion. This, together with the contained tooth structure, favored a tentative x-ray diagnosis of odontoma.

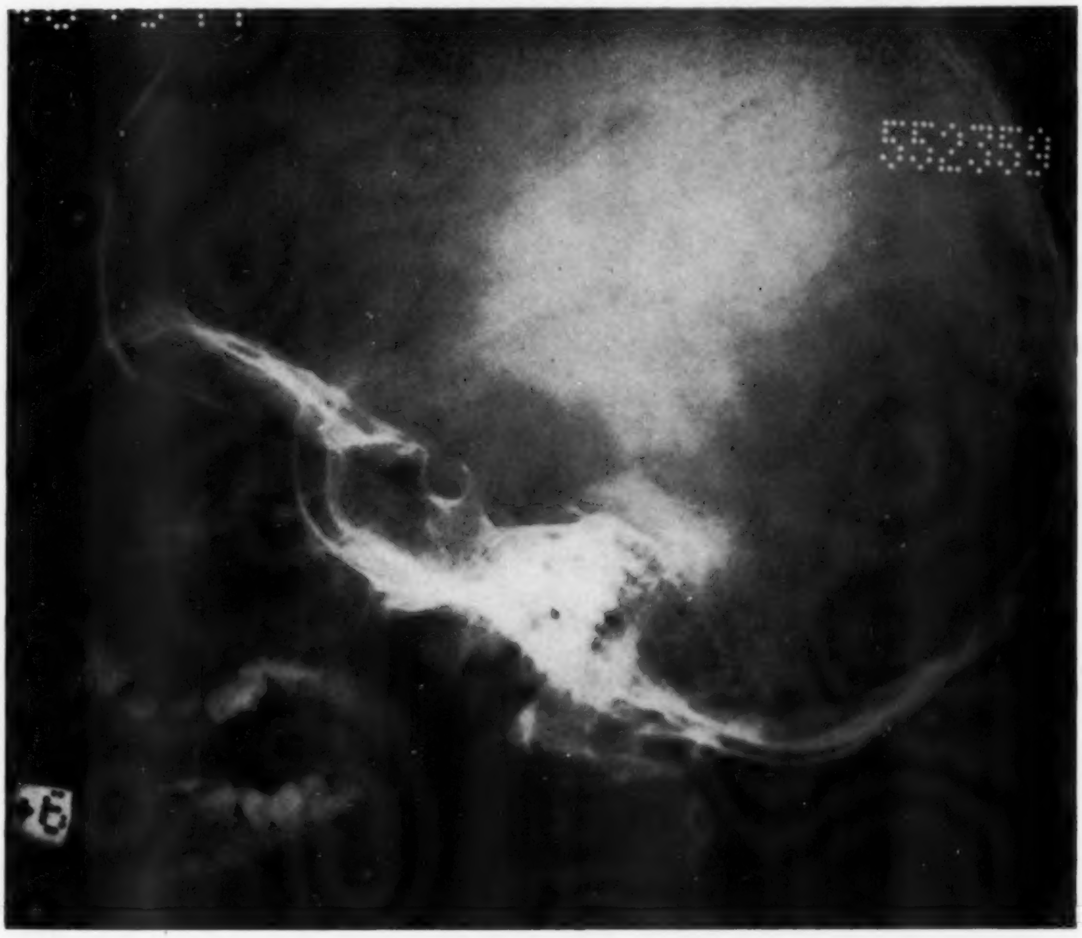

Fig. 6.—*See opposite page for legend.*

Because of the history of rapid growth and the loose second deciduous molar, it was felt that a microscopic evaluation to rule out sarcoma was indicated.

A biopsy was made from the crest of the alveolar ridge including the mobile molar. This showed, on microscopic examination, myxomatous connective tissue with an occasional nest of cells with a palisade suggesting adamantinoma. There was also a small cyst lined by columnar epithelium.

The patient was operated on under intratracheal nitrous oxide and ether anesthesia. An incision was made on either side of the crest of the alveolar ridge, parallel to and about 1 cm. above the gingival margins. These were carried from the incisor region to the tuberosity so as to include tissue well outside the biopsied area. The mucoperiosteum was elevated from the buccal and palatal processes. The buccal plate of bone was parchment paper in thickness, but otherwise it, as well as the palatal process, appeared normal.

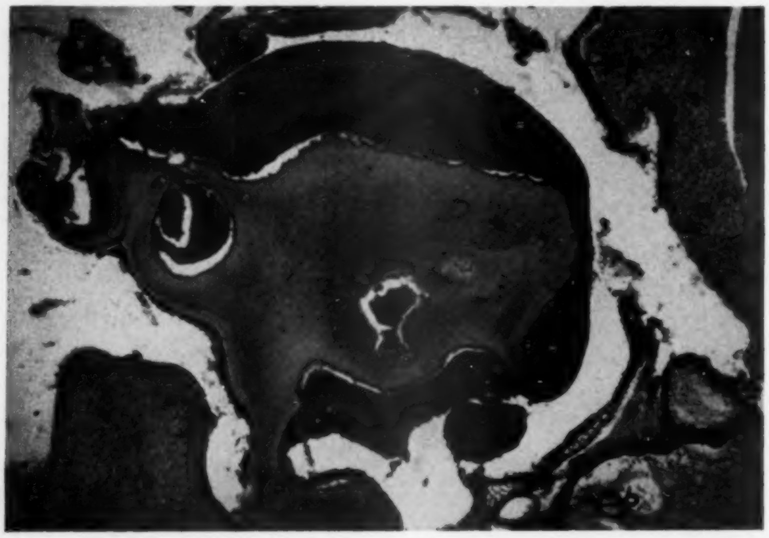

Fig. 7.—Photomicrograph showing atypical tooth structure. Irregular mass of dentine surrounded by enamel matrix. Epithelial elements on periphery of mass. *En*, Enamel; *Ep*, epithelium; *D*, dentine. Hematoxylin and eosin. ×40.

A large section of the thin buccal plate was removed, exposing an encapsulated tumor which stripped away from the bony walls with ease. In order to give access to the anterior pole of the tumor, the alveolar process, including the first deciduous molar, was removed. This exposed the unerupted crowns of the two premolars which were lying in a dense cellular tissue. The neoplasm extended anteriorly to the deciduous cuspid, which also was extracted and showed erosion of the posterior portion of the upper third of its root. Beginning anteriorly, the heavy capsule was easily teased free from the walls of the bony cavity. The tumor was enucleated as far back as the posterior extremity of the maxilla, where it was found to have eroded through the zygomatic surface and tuberosity and to have extended into and completely filled the pterygopalatine fossa. By gentle and steady traction the posterior portion was completely extirpated. The capsule of the tumor was very thick and intact except for a wide rupture at the point where a section had previously been excised for a histological examination. Together with the complete neoplasm, the surgical specimen also included all of the excised alveolar ridge posterior to the lateral incisor as well as a large section of the buccal and palatal plate. The remaining cavity, which measured 6 by 6 by 6 cm., was packed with a large petrolatum gauze dressing.

The gross specimen consisted of a tumor 6 by 6 by 6 cm. completely covered by a very thick leathery capsule. On sectioning, it consisted of a soft, pink,

fleshy mass, containing a very large number of calcified bodies varying in size and shape. Some resembled rudimentary teeth. There were two well-formed molar crowns (probably first and second molars), as well as two conglomerate masses measuring 1 by 2 cm.

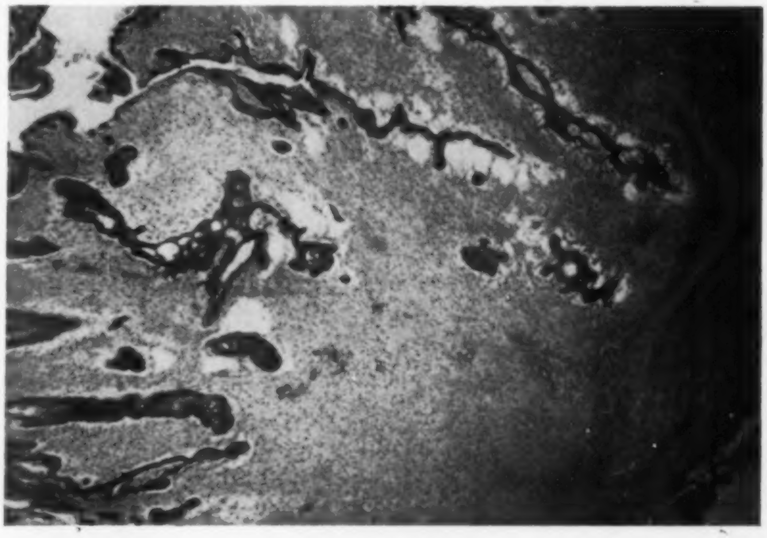

Fig. 8.—Cords and masses of epithelial cells in delicate connective tissue stroma. Typical areas of adamantinoma. Hematoxylin and eosin. ×40.

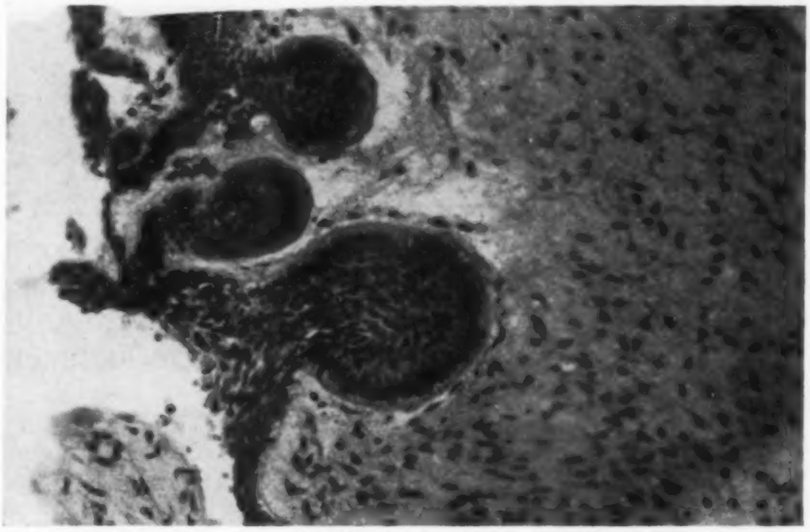

Fig. 9.—Higher magnification of epithelial mass showing characteristic morphology and arrangement of cells. Hematoxylin and eosin. ×100.

Microscopic Examination.—"The specimen received measured 5 by 6 by 6 cm. and was surrounded by a dense fibrous capsule. The mass cut with difficulty because of the numerous areas of calcification. One cut section of the interior of the mass was a conglomerate of varying sized glistening white structures, some of which appeared to be atypical teeth. In other areas the mass was more solid, had a mottled appearance, and contained areas of calcification.

"The periphery of the mass was dense fibrous connective tissue in which high cuboidal to high columnar epithelial cells were found in masses, strands, and anastomosing cords. The cells were arranged in a parallel or palisade fashion at the margin of the masses and cords. Many cells were tall, columnar, with basally placed nuclei, and appeared to be atypical ameloblasts. Toward the interior of the mass these groups of cells became larger and surrounded small cystic spaces. They also were found associated with masses of embryonic connective tissue. The main bulk of the interior of the structure was composed of masses of enamel matrix, dentine, and cellular and acellular cementum in an atypical relationship. This therefore is a complex neoplasm showing typical areas of ameloblastoma and the characteristics of a complex composite odontoma. Diagnosis: Adamanto-odontoma." (Figs. 7 to 10.)

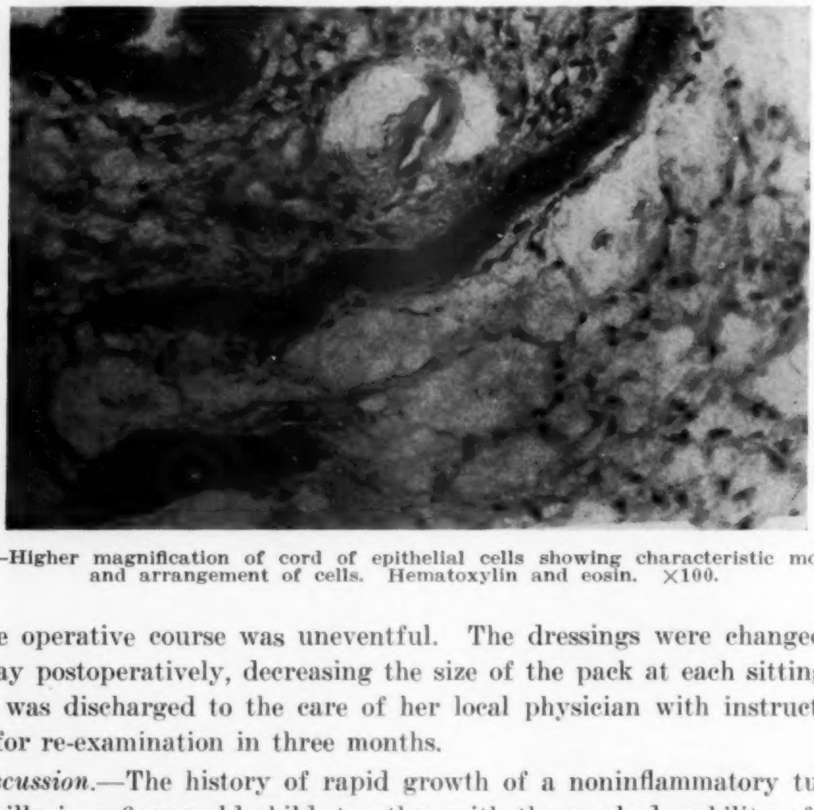

Fig. 10.—Higher magnification of cord of epithelial cells showing characteristic morphology and arrangement of cells. Hematoxylin and eosin. ×100.

The operative course was uneventful. The dressings were changed every third day postoperatively, decreasing the size of the pack at each sitting. The patient was discharged to the care of her local physician with instructions to report for re-examination in three months.

Discussion.—The history of rapid growth of a noninflammatory tumor of the maxilla in a 6-year-old child, together with the marked mobility of a noncarious, vital deciduous second molar, strongly suggested that we might be dealing with a malignant neoplasm, possibly a sarcoma. After obtaining the radiographic evidence of the marked degree of expansion by the tumor of the superior and lateral walls of the maxillary sinus with no demonstrable erosion of the bone, we favored the diagnosis of a benign tumor. The numerous calcified bodies, appearing as a more or less conglomerate mass containing what appeared to be the crowns of unerupted premolars and permanent molars, favored the radiographic diagnosis of cystic odontoma. This was a possibility in this case since odontomas develop and may increase to a large size during the period of dental development.

Radiographically there was nothing to suggest any of the other usual tumors of the jaw, and a positive evaluation by microscopic examination was indicated before surgery was instituted. With the pathologic diagnosis of adamantinoma, the question arose as to how radical should be the treatment. It is generally agreed that conservatism in the treatment of adamantinoma frequently results in recurrence and many of the cases so handled eventually require further surgery. Although adamantinoma may be considered a benign tumor, instances of metastasis have occurred. Malignant degenerative changes are apt to occur with frequent recurrences.

Yet in this case, because of the heavy capsule which afforded easy and apparently complete enucleation, and the fact that its location offered technical difficulties and surgical restrictions, radical surgery was contraindicated. It was felt that a mutilating operation should be done only in case of future recurrence.

This is a case of a rare, mixed odontogenic tumor. Associated with the development of a dental anomaly (odontoma) there was also a proliferation of the epithelial elements to create an ameloblastic tumor.

LYMPHANGIOMATOUS MACROGLOSSIA

Report of a Case

John W. Kemper, D.D.S., M.D.,* and Herbert J. Bloom, D.D.S., M.D.†

MACROGLOSSIA, by definition, denotes an abnormal enlargement of the tongue. Explicitly the term covers two common forms; muscular hypertrophy, and enlargement, or dilation of the lymphatic spaces. We shall confine ourselves to the commonest form—the so-called "lymphangiomatous macroglossia."

The true etiology is slightly clouded by conflicting opinions. Most authorities, however, agree that it is an endothelial tissue tumor composed of dilated lymphatic spaces. It is of congenital origin, often appearing at birth or shortly thereafter, although it may remain quiescent for a long period and become noticeable after dentition or before puberty, at which time it may become the seat of characteristic attacks of inflammation followed by periods of remission.

The picture of lymphangioma of the tongue is so striking and characteristic that it is worthy of mention. Minute clear vesicles appear on the surfaces of the tongue, between which are scattered capillary loops appearing as bright red dots. Many capillaries protrude into the vesicles and, because of the thinning of the walls, are prone to rupture, thereby changing the color of the vesicle to bluish black. Dilation of the lymphatic spaces is accompanied by inflammation, with the formation of dense intercystic connective tissue. There is progressive increase in the number of thin-walled, coiled arteries and veins, and, with exacerbations, there is coincident blood extravasation into the lymphatic cavities.

With increase in size there is inability to close the mouth, and the tongue gradually protrudes beyond the oral cavity. The exposed portion of the tongue becomes dry, crusted, fissured, and hemorrhages freely. With trauma, ulceration may occur, and with each inflammatory episode there is resultant fibrous tissue deposition and consequent further enlargement. Mastication becomes difficult, speech is blurred, and saliva dribbles from the mouth. In young patients there is distortion of the mandible in the form of depression of the horizontal rami, and if dentition is present the incisor teeth may incline labially.

Interestingly, as in the following case, many observers report associated cervical hygromata or other forms of lymphangiomata of the face and neck. The association is curious and not clearly understood.

Therapy is confined to radiation, ignipuncture, or surgical intervention. The latter is usually carried out by removal of a wedge-shaped section or marginal resection of the tongue. A combination of all procedures may have merit in some cases.

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CASE REPORT

History.—E. T., No. 516226, a 17-month-old girl, was admitted to the University Hospital in November, 1942, with the chief complaint of enlargement and bleeding of the tongue. The mother stated that the onset of illness was approximately four months prior to this date with an insidious swelling of the tongue accompanied by bleeding from its surface. The signs increased in severity and the tongue gradually protruded from the mouth, permitting the exposed surfaces to become dry and increasing the extent of the hemorrhage. The child apparently ate well without significant pain; however, she choked frequently during deglutition.

The patient had been a full-term baby, born of a normal delivery, and had been entirely well during the early months of her life. The familial history was noncontributory.

Fig. 1.—Photograph showing enormous tongue protruding from the mouth. Note small vesicles and dark nodules with crusting of blood and debris along the margins.

Examination.—The child was well developed, well nourished, but with a marked pallor, and appeared chronically ill. The gross deformity of the tongue was obvious as it appeared to be about two and a half times its normal size and protruded about 2 cm. beyond the edges of the anterior teeth, causing the mouth to remain constantly open. The organ was firm and freely movable. Demarcation between normal and abnormal tissue could not be detected. The surface had a purplish color with scattered vesicles, and bright red, tiny elevations over its greater portion. Hemorrhagic tendency was moderate at the margins. A slight fullness was noted in the left submaxillary area, but the

borders could not be outlined by digital examination. Further detailed examination did not disclose other evidence of significant disease.

Laboratory Data.—The blood Kahn was negative; the urine findings were normal. On admission, the hemoglobin was 55 per cent (Sahli); red blood cells 1,800,000; white blood cells, 3,000, with a normal differential.

Radiographic Findings.—The lungs were negative; the airway through the pharynx appeared adequate; the thymus was not enlarged. Examination of the long bones revealed normal epiphyseal development.

Course.—Following admission, the child was placed on a general supportive regime, and repeated whole blood transfusions were instituted. At the end of a week the hemoglobin had risen to 88 per cent. Under an ether anesthetic the tongue was biopsied, and the pathologist returned a diagnosis of cavernous lymphangioma with hemorrhage into the angiomatous spaces.

Radiation therapy as a form of treatment was ruled out after the radiologists declared that significant improvement could not be expected by this method. The case was then presented before a conference composed of members from the staffs of the various branches of medicine and surgery that were interested in this special problem. Representatives of the Departments of Pediatrics, Otolaryngology, General Surgery, Oral Surgery, and Anatomy attended, and a discussion ensued as to the possibility of the lesion being a manifestation of lymphatic obstruction rather than true neoplastic tissue. Partly to satisfy a few of the members of the hospital staff who favored the obstruction theory and also to examine adequately the fullness of the left side of the neck, it was agreed to explore the cervical lymphatics and to do a partial marginal glossectomy in order to create a wound with a large surface area that would, through wound healing, create a larger lymphatic bed and possibly increase lymph drainage by the proliferation of new lymph vessels.

Under ether anesthesia, a few drops of pontamine sky blue dye were first injected into the tip of the tongue to facilitate visualization and to demonstrate the lymphatics of the tongue. There was almost immediate discoloration of the complete tongue with the exception of the margins of the posterior third. A 2 inch horizontal incision was then made extending from the angle of the mandible anteriorly and 2 cm. below the inferior border. After penetrating the superficial fascia, what appeared to be a thin-walled cyst came into view. Aspiration substantiated these suspicions, by obtaining a turbid fluid. There was no trace of the blue dye injected into the tongue. A radiopaque oil (lipiodol) was then injected into the cystic space. Radiograms of the neck were made immediately, and operative procedures were discontinued pending radiographic findings. The radiograms disclosed the opaque medium to be present in a large multiloculated bizarre pool extending on the left side into the floor of the mouth and upper cervical region.

Following an adequate preparatory program, the child was again returned to the operating room and the cervical wound was reopened to explore and remove the cystic lymphangioma. It was found to be a multilocular cyst extending into the submaxillary triangle and into the lateral pharyngeal space. Many thin-walled loculi containing amber-colored fluid were opened. As complete removal of the very thin-walled cysts was a surgical improbability, and because of its dissecting tendency and close adhesions to important structures

and larger vessels, the septa were broken down to form one large cavity. This was packed loosely with a gauze dressing saturated with 5 per cent solution of sodium morrhuate. The histopathology of a tissue specimen from this area revealed it to be compatible with a diagnosis of cavernous lymphangioma or cystic cervical hygroma. The right cervical region was also explored surgically, but no cysts could be demonstrated.

Fig. 2.—Soft tissue radiograph illustrates the enormous size of tongue. Note the labial inclination of the anterior teeth and deformity of the body of the mandible due to pressure of the tongue.

Postoperative care included changing the sodium morrhuate dressing at forty-eight-hour intervals, decreasing the size of each succeeding dressing. At the end of ten days the cystic cavity was completely obliterated. Repeated whole blood transfusions were continued to replenish the constant blood loss from the tongue.

Fig. 3.

Fig. 4.

Figs. 3 and 4.—Lateral and posteroanterior radiographs showing size and position of multi-loculated cyst of floor of mouth and cervical region, demonstrated by lipiodol injection.

Two weeks following the last operation the patient was returned to the operating room, where, under ether anesthesia, a V-shaped section of tissue was removed from the margin of the tongue on either side, extending from the posterior third anteriorly through the middle third. The section measured approximately 7.5 cm. in length and 0.5 cm. in width and extended to the midline of the body of the tongue. It was hoped that the procedure would produce a tongue of diminished size by actual removal of tissue and that with wound healing a wider bed of lymphatic drainage would be created by proliferation of lymphatic vessels.

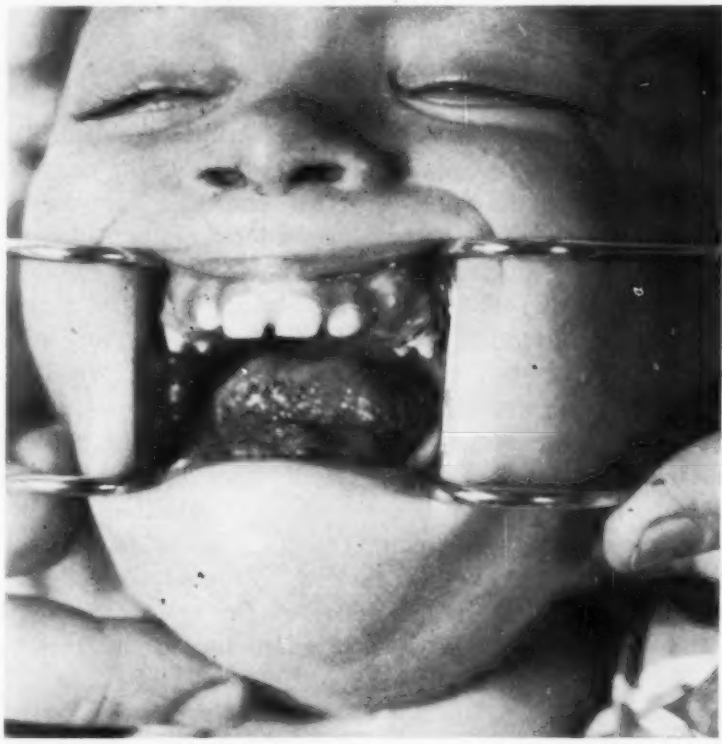

Fig. 5.—Photograph three months postoperative. The tongue is normal in size and contour and function. Along the margins can be seen some of the remaining lymphangiomatous tissue.

As the operation failed to produce the desired result, six weeks later a more extensive partial glossectomy was performed. This was carried out by making two vertical incisions through the body of the tongue, each starting about the mid-portion and directed forward and laterally. The result was the removal of a V-shaped section from the mid-anterior region through its entire thickness. The removed tissue was about 4.5 cm. in length including the anterior third of the tongue. The lateral sections were then approximated in the midline, producing a fairly well-shaped tongue which could be entirely contained within the oral cavity. There was no troublesome postoperative bleeding. It was noted, however, that a deformity of the mandible had been produced in the form of a depression of the anterior portion of the body of the mandible with a resultant anterior open-bite relationship of about 1 cm. The immediate and subsequent postoperative course was uneventful, and the patient was discharged on the tenth postoperative day for an observation period.

Six months later, E. T. was again admitted to the hospital after a completely negative interim. Oral examination revealed the tongue to be well healed, with an excellent cosmetic and functional result. There appeared to be residual neoplastic tissue over the dorsum and tip of the tongue, and a mass of lymphangiomatous tissue, about 1 cm. in diameter, could be outlined in the floor of the mouth just lingual to the incisor teeth. The latter was removed during this admission and healing occurred without complication.

Subsequent checkup examinations to date have not revealed significant changes; however, it is expected that further surgery of the tongue may be required.

COMMENT

Lymphangiomata commonly involve the tongue and may be single, multiple, unilateral, or bilaterally diffuse as in this case. The latter type is the rarest of the lymphangiomata of the tongue. The solitary and unilateral lesions which are well demarcated usually offer little difficulty in eradication by excision, but the bilateral diffuse type create a more complicated problem. Cavernous lymphangiomas are generally considered not an obstruction of the lymphatics but a true neoplasm and must be treated as such. The use of radium, electrocoagulation, and partial glossectomy are the usually accepted methods of treatment. Radium and ignipuncture create more scar tissue, resulting in a more rigid organ, than surgical excision. Prognosis is generally good even though complete excision is not possible in the extensive tumors.

The lining membrane of the multilocular cervical cyst was so thin, with adhesions to the adjacent large vessels and other structures, that complete surgical removal was thought to be impossible. It was felt that by rupturing all of the loculi and creating one large cavity, the endothelial cells could be destroyed by the use of a sclerosing solution. Another similar case of a large lymphangiomatous cyst involving the floor of the mouth and extending into the base of the tongue was satisfactorily treated by us with this method.

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Original Articles

RARE (UNUSUAL) MALIGNANT TUMORS OF THE JAWS

Irving Salman, D.D.S.,* and Charles G. Darlington, M.D.,†

Most carcinomas of the mouth are primary in origin. On the other hand, metastatic carcinomas to the jaws, as reported in the literature, are comparatively rare.

It is quite possible that if routine radiograms of the jaw had been taken when looking for such metastatic lesions, these secondary lesions could be more frequently detected. For proper diagnosis, radiograms of the skull cannot be used because of overlapping of the sides of the mandible. The routine extraoral and intraoral films are the only ones indicated.

There are many primary tumors responsible for bone metastases. The most frequent sites, according to Geschickter and Copeland[3] in 334 cases, were from: (1) prostate, (2) breast, (3) kidneys, (4) gastrointestinal tract, etc. There were 36 cases of undetermined source.

On occasion, the jaws are the first place in which the metastatic lesion is discovered. In the early stages, pain and sometimes swelling may be the chief complaint. The clinical and radiographic differential diagnosis is sometimes very difficult to make. It is because of this difficulty that histological tissue examination should be resorted to as an aid in establishing a diagnosis. Following the identification, a search for the primary site should be made.

Eleven cases of metastatic tumors are reported in this paper. In seven of these cases the oral cavity was the first location in which the metastatic lesion was discovered. In the remaining four cases there were other metastatic manifestations besides the oral ones. The cases reported are as follows:

Metastatic carcinoma	4
Lymphosarcoma	2
Ewing's tumor	2
Multiple myeloma	2
Kaposi sarcoma	1

METASTATIC CARCINOMAS (4 CASES)

In the first three cases of this group the lesions occurred in the lower jaw. The radiographic pictures in each of these cases were different. As for clin-

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The opinions or assertions contained therein are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large. (Art. 113 [2] U. S. Navy Regulations.)

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ical symptoms, in Case 1, the first complaint was pain in the jaw, in Cases 2 and 3, the chief complaint was a swelling of the jaw. In Case 4, a hypernephroma, the lesion was found in the upper jaw.

Case 1.—S. E., white, male, aged 53 years. The patient gave a history of having been struck by an automobile in May, 1936. He was admitted to Ruptured and Crippled Hospital with fractures of the upper third of the tibia and fibula extending into the knee joint. An open reduction operation was performed at this hospital. In August, 1936, the patient was admitted to Montefiore Hospital for treatment of the left knee joint.

One month after admission to Montefiore Hospital, the patient complained of pain in the lower right jaw. The radiogram (Fig. 1*A*) showed osteoporosis with numerous "soap bubble" areas or cysts extending from the angle of the mandible to the first premolar. There was also evidence of a horizontal line of fracture involving the lower border of the mandible. A biopsy was taken and a diagnosis of "metastatic carcinoma" was made (D. Perla) (C. G. D.).

A complete and very careful study failed to reveal evidences of the primary site of the lesion. On Jan. 23, 1937, the patient left Montefiore Hospital of his own accord. Three months later a radical removal of the cervical lymph nodes on the right side, together with a resection of the right mandible and related structures of the soft parts adjacent to the tumor, was performed at some other hospital. The patient died the evening of the operation, following what appeared to be an acute heart block. Dr. A. P. Stout reported the tumor as a "carcinoma, metastatic from a carcinoma in some unknown primary site."

Case 2.—C. S., white, female, aged 50 years. (Courtesy of Dr. Gransean, Meadowbrook Hospital.) The patient gave a history of having fallen down a flight of stairs on April 1, 1935. She noticed about one month later a swelling of the lower right jaw in the region of the angle of the mandible. Radiograms taken by her dentist revealed two third molar roots. They were subsequently removed. Two weeks later a growth, apparently cystic, was removed from the lower right molar area. The histological tissue report was "squamous cell carcinoma" (Long Island Research Laboratory). The patient received radiation therapy at the Meadowbrook Hospital. The treatment produced some shrinkage of the tumor mass.

In August, 1935, the swelling reappeared at the same site. (Fig. 2*A*.) The patient reported to the New York University, College of Dentistry. A biopsy was performed and a diagnosis made of "metastatic carcinoma—suggestive of breast, kidney, or lung" (C. G. D.) (Fig. 2*B*). There were no clinical symptoms or signs elsewhere in the body. The patient was admitted to the Meadowbrook Hospital, where radiation therapy this time gave but temporary relief to the pain and swelling which was now present. Complete physical examination and extensive radiographic studies were made and the conclusion was drawn that the patient had a primary bronchogenic carcinoma.

The patient died in October, 1936, one and a half years following the appearance of the oral symptom. No autopsy was performed.

Case 3.—S. R., white, male, aged 49 years. Four months prior to admission (September, 1939) to Montefiore Hospital, the patient was jaundiced and had

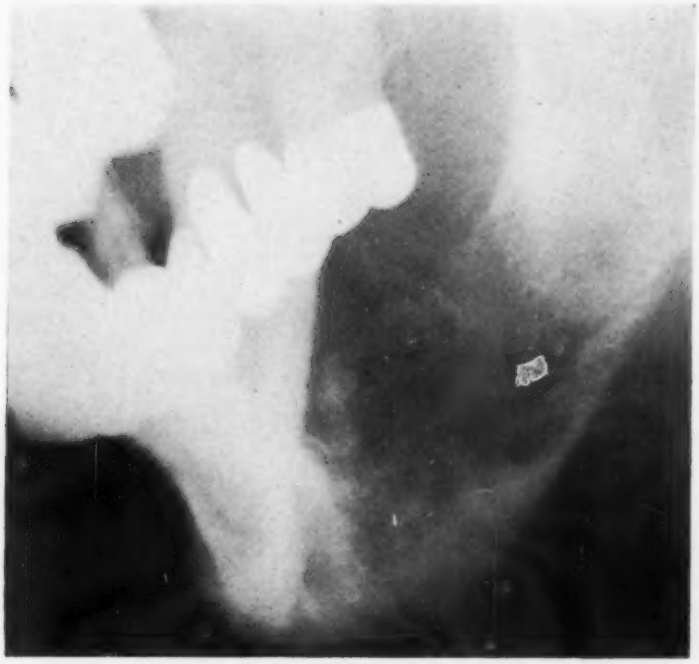

Fig. 1*A*.—Radiogram of the right mandible showing osteoporosis with numerous "soap bubble" areas or cysts. There is evidence of a horizontal line of fracture involving the lower border of the mandible.

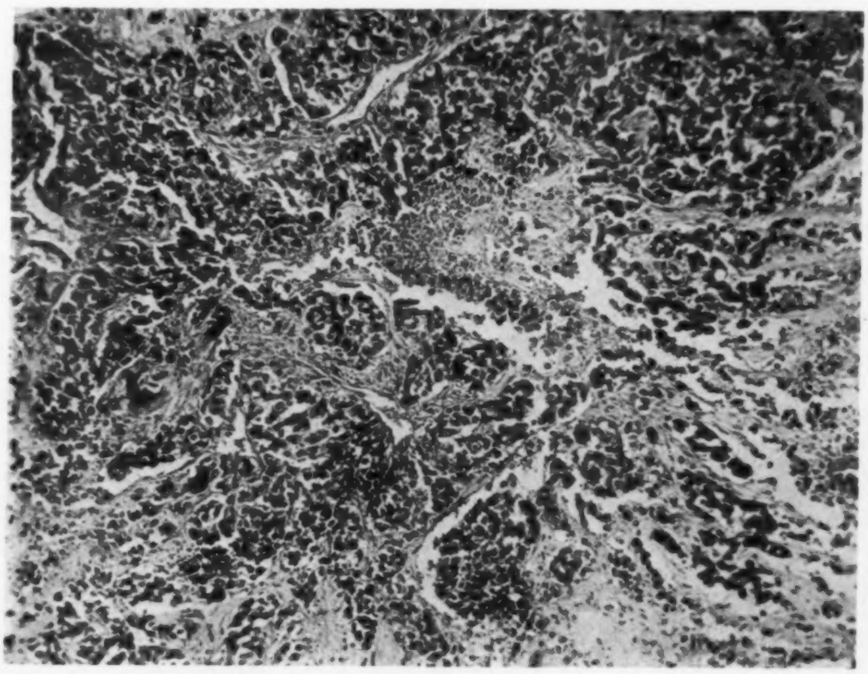

Fig. 1*B*.—Photomicrograph showing strands of anaplastic epithelial cells with a splinter of viable bone near the top.

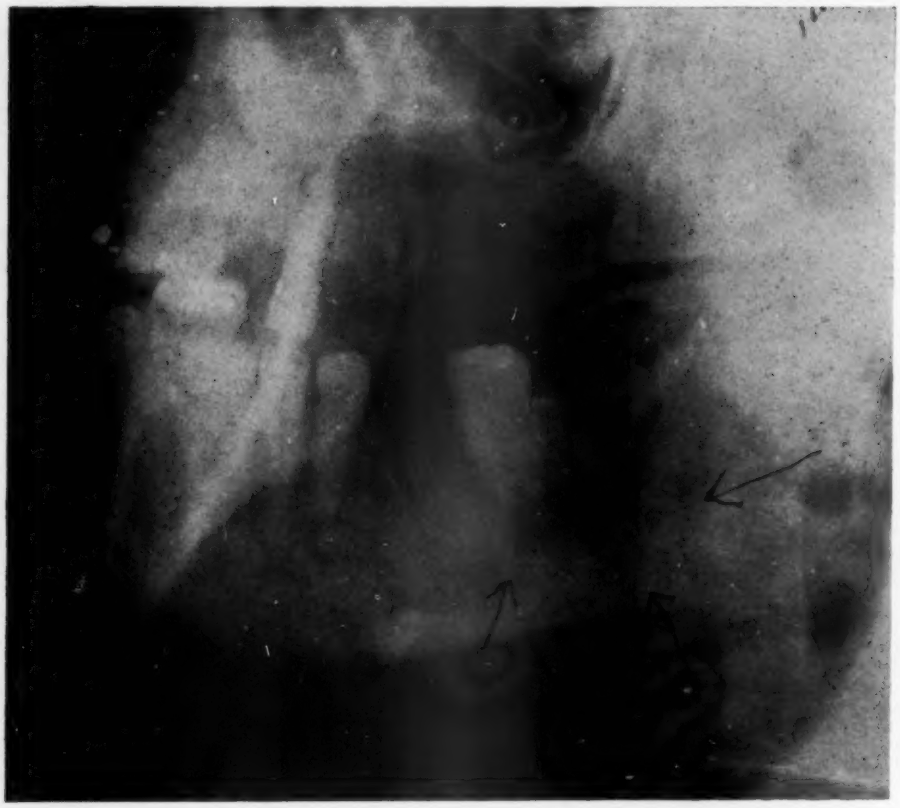

Fig. 2A.—Radiogram of the right mandible showing a radiolucent area of destruction of bone in the third molar region.

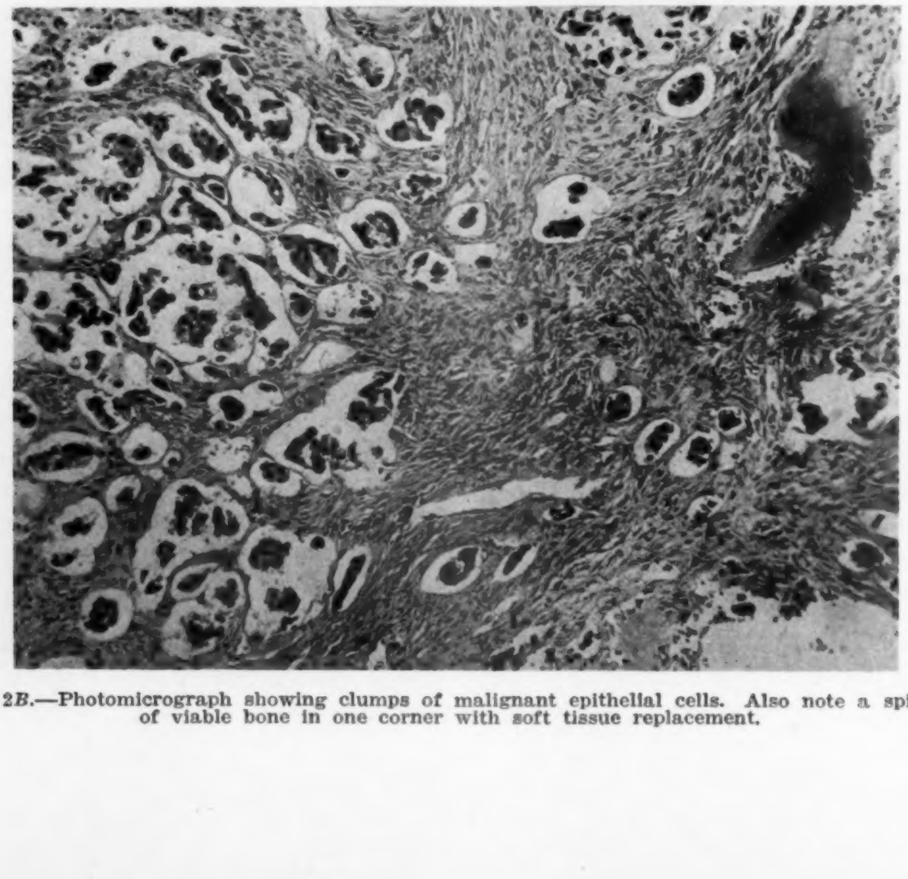

Fig. 2B.—Photomicrograph showing clumps of malignant epithelial cells. Also note a spicule of viable bone in one corner with soft tissue replacement.

Fig. 3*A*.—Radiogram of right mandible showing two separate areas of bone destruction; the anterior area appears to be a radicular cyst, the posterior area is not a typical cyst.

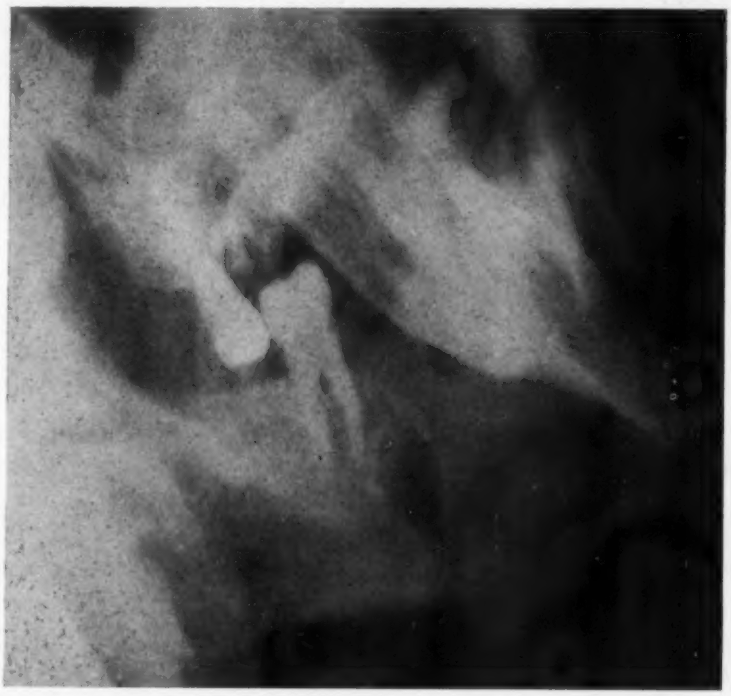

Fig. 3*B*.—Radiogram of left mandible showing several areas of bone destruction with well-defined margins which are similar to cysts. In view of the diagnosis found on the right side of the mandible, we must consider these to be metastatic lesions.

severe gastric hemorrhage. At that time he was admitted to Beth Israel Hospital, where he received no special treatment. When admitted to Montefiore Hospital, a tentative diagnosis was made of "carcinoma of pylorus and duodenum with metastasis to lungs and liver."

The patient presented himself at the dental clinic of Montefiore Hospital with a swelling of the lower right mandible. This swelling extended from the cuspid to the molar area and was about the size of an egg. Clinically, the underlying bone was of an eggshell consistency. Upon pressure, pus exuded from a sinus located on the crest of the ridge.

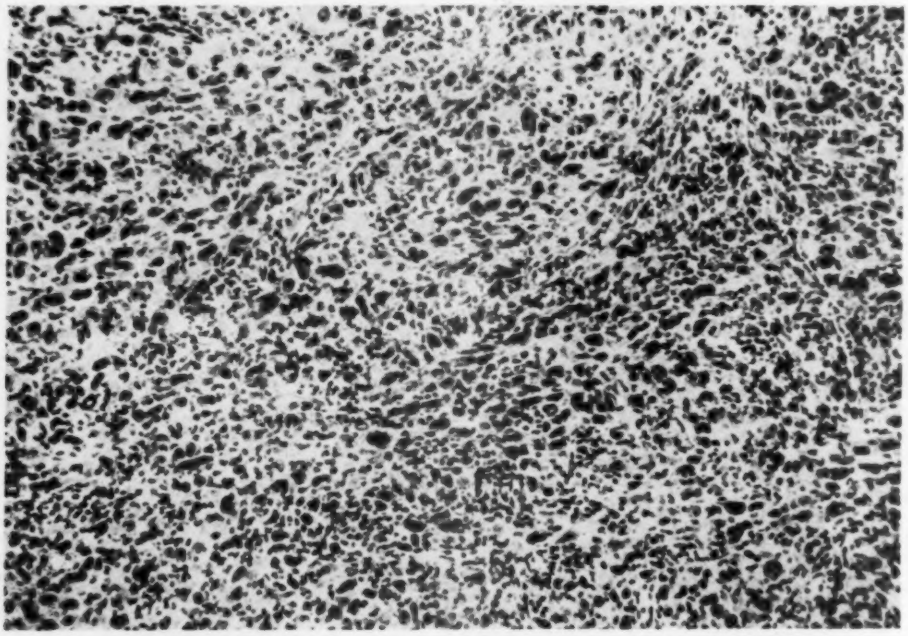

Fig. 3*C*.—Photomicrograph showing pleomorphic and anaplastic malignant cells.

A lateral plate (Fig. 3*A*) of the right mandible showed two large areas of bone destruction. One area, about 2 cm. in diameter, extended from the premolar to the molar region and from the lower border of the mandible to the alveolar crest. The other, about ½ cm. in diameter, was located at the apex of the lower right cuspid. The anterior—smaller—area appeared, radiographically, as a radicular cyst. The larger area aroused suspicion of a neoplasm. Under a mandibular nerve block anesthesia, both areas were enucleated. The material removed was somewhat necrotic but did not resemble the classic cyst. (Radiograms were also taken of the left mandible (Fig. 3*B*). The tissue was reported (Fig. 3*C*) as "malignancy and chronic infection. The exact nature of this neoplasm cannot be determined." (D. Perla.)

The patient continued ill and went rapidly downhill. He died Sept. 26, 1939. No autopsy was performed. The final diagnoses were: "Carcinoma of stomach with metastasis to liver, lungs, and mandible; anemia, secondary to malnutrition; jaundice."

Hypernephroma.—According to Thoma,[2] Branch and Morton (1928) reported a case of hypernephroma with secondary lesions of eighteen months' duration located on the lingual surface of the mandible. Stein (1929) reported a similar case with a tumor in the labial gingiva of the maxilla between the first and second incisors.

CASE 4.—M. B., white, female, aged 54 years. The patient was admitted to the Bronx Hospital on March 2, 1935. Her chief complaints at that time were loss of weight and hematuria. A diagnosis of "tumor of the right kidney" was made and a right nephrectomy performed. The pathologic tissue report was "renal carcinoma with clear cells—hypernephroma" (Fig. 4*C*). The patient was given radiation therapy postoperatively. One year following treatment a nodule appeared in the skin near the scar of the operation. Later, nodules appeared on the scalp. These grew rapidly in size and ulcerated. About two years later, a nodule appeared on the hard palate.

Fig. 4*A*.—Clinical photograph showing a metastatic growth in the frontal region.

The patient was admitted to Montefiore Hospital, Nov. 19, 1937, with metastatic growths on the scalp and palate. On admission, the patient had an irregular growth on the scalp, about 2 inches in diameter, to the left of the midline in the parietal region. There were two soft growths in the frontal region (Fig. 4*A*). On the hard palate (Fig. 4*B*) there was a nodule about 1½ by 1 inch. This nodule was firm to the touch and showed beginning ulceration. The nodule grew larger, ulcerated, and bled, particularly after meals. The growth eventually filled the oral cavity. After extensive radiotherapy the tumor shrank.

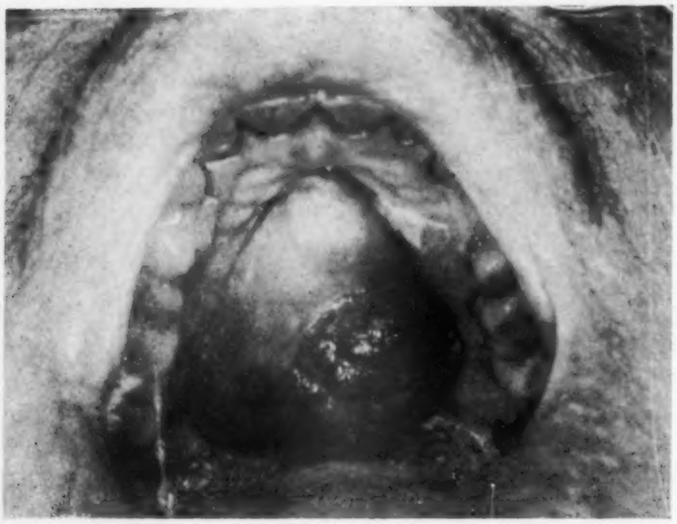

Fig. 4*B*.—Clinical photograph showing metastatic growth almost covering the entire hard palate.

Fig. 4*C*.—Photomicrograph showing clear cells indicative of a "hypernephroma." This section was taken from the kidney. (Courtesy of Bronx Hospital, New York.)

When treatment was discontinued, the growth grew rapidly again. At the time of death the growth filled almost the entire oral cavity.

The patient died, March 24, 1938. There was no autopsy performed nor was any biopsy material taken from the mouth lesion. The final diagnoses were: "Right hypernephroma (postnephrectomy) with metastasis to skull, skin, palate, lungs, and retro-orbital tissues."

LYMPHOSARCOMA

This tumor varies in malignancy. It may manifest itself in a simple localized process or be distributed throughout the lymphatic tissues of the body. It is most frequently seen as tumor masses of the lymph nodes. Thoma[2] states that no cases occurring in the jaws have been found in the literature. Copeland[3] reports that bone metastasis occurred in 1 per cent of 300 cases of lymphosarcomas at the Memorial Hospital, New York, N. Y.

CASE 5.—F. W., white, female, aged 35. In October, 1937, while a patient of the Outpatient Department of Montefiore Hospital, a biopsy of a nodule in the chest wall was diagnosed as "reticular cell sarcoma" (D. Perla). (In November, 1936, a biopsy from the left breast had been performed and the tissue reported as an "adenoma"—D. Perla.)

The patient was admitted to Montefiore Hospital, Jan. 23, 1937, with the diagnosis of "lymphosarcoma." There was hypertrophy of the papillae of the tongue. The gingiva of the lower jaw was hyperemic. The pharynx was clear.

In the right submaxillary region, 3/4 inch anterior to the angle of the mandible, there was a freely movable but not tender mass. There was a soft node 1½ cm. in diameter in the right axilla, which was movable, firm, but not tender. The mass measured 8 by 8 cm. In the left axilla there were two similar smaller masses and below these on the lateral chest was a single, firm nodule, measuring 2 cm. in diameter.

The breasts showed signs of cystic mastitis. The liver was enlarged downward; right and left lobes descending 1½ cm. below the umbilicus. A few small iliac glands could be felt on the right side. Though no masses were present in the rectum, the area was tender.

On admission there was a growth in the lower right mandible extending from the right cuspid to the right second molar region and from the mucobuccal fold (Fig. 5*A*) to about 2 cm. above the occlusal surfaces of the molar teeth. The surface was invaginated because of occlusion of the upper teeth on the denture. This mass was soft. According to the patient, the duration of the lesion was about three weeks.

The patient went rapidly downhill and died on Feb. 24, 1937. An autopsy was performed. The anatomical diagnoses were: "Generalized sarcomatosis with involvement of axillary lymph nodes, chest walls, lungs, pleura, spleen, stomach, gall bladder, periosteum, and gingiva; pulmonary congestion; ascites."

CASE 6.—T. H., white, female, aged 7½ years. The patient was admitted to the New York University, College of Dentistry Clinic on July 8, 1927. The history revealed that there was a swelling of the right side, which was tender

Fig. 5A.—Clinical photograph showing growth on the right mandible. Note that the surface of the lower gum is invaginated by the upper teeth.

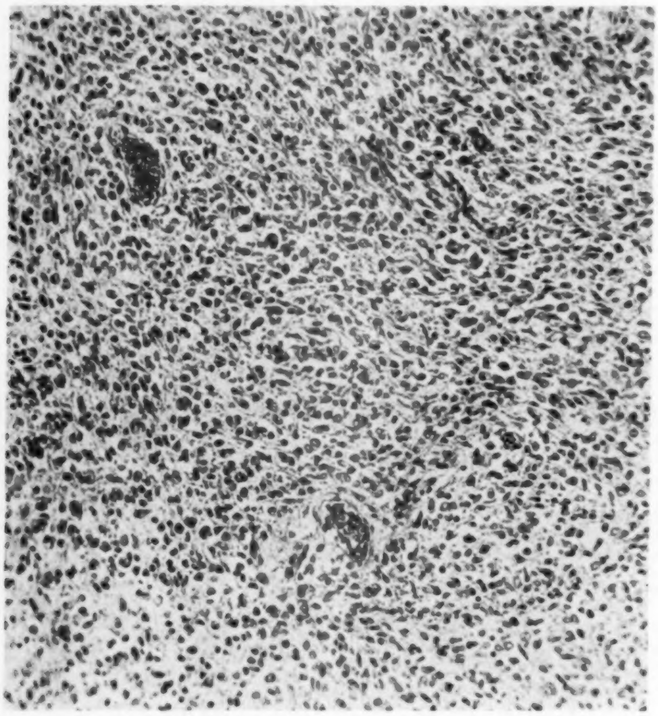

Fig. 5B.—Photomicrograph showing malignant lymphocytic cells.

and began seven weeks prior to admission. This was thought to be an abscess by a dentist who removed two teeth. No pus was evacuated. The patient "ran" some temperature and was in bed for three weeks following the extraction. The dentist then incised the gum but obtained no pus.

On admission there was externally a diffuse swelling of the right cheek with a localized hard walnut-sized mass palpable over the cuspid area. In was tender upon pressure. The right side of the lips were puffed and the right cheek thickened. The right ala of the nose was slightly involved in the swelling. Intraorally, there was a diffuse purplish discoloration on the mucosa of the cheek opposite the upper right cuspid and first premolar. Two swellings were present on the palate: (1) An oval, tense, and compressible elevation, 1 by ¾ inch, involving the upper right lateral incisor, cuspid, and first premolar area. There were no distinct demarcations. The lesion was elevated about ½ inch. There was a normal color to the mucous membrane extending along the palatal side of the ridge halfway up between the gingival margin and the midline of the palate. (2) A walnut-sized swelling extending posteriorly including the tuberosity and the distal gingiva of the first permanent molar. The mass was hard and tender upon pressure.

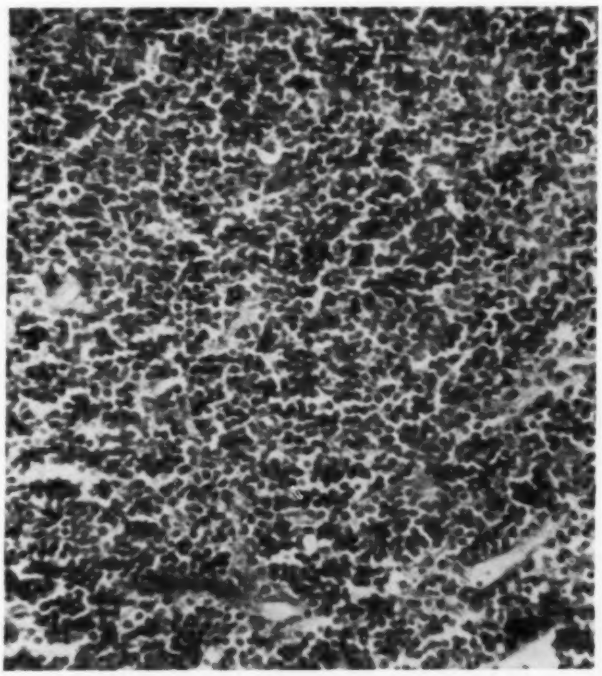

Fig. 6.—Photomicrograph of a lymphosarcoma.

The radiograms showed an upper unerupted cuspid and clouding of the right maxillary sinus. A biopsy was performed and a pathologic diagnosis of "round-cell sarcoma" (C. G. D.) was made (Fig. 6). The patient was referred to the Bellevue Hospital, where she died one month later. The main findings at the autopsy were: "Lymphoid tumor in gut and antrum—Sternberg's disease."

EWING'S TUMOR

Ewing's tumor, also called "endothelial myeloma," is considered rare, although Geschickter and Copeland[3] reported they had in their collection of 323 cases, 11 cases of jaw tumors. Three cases have been reported to the registry[2] in patients over 40 years of age.

The tumor arises from the endothelial lining of blood vessels or lymphatics. Generally, it occurs in early life, between 4 and 25 years of age. The bones most frequently involved are the tibia, fibula, humerus, and the femora. The skull, maxilla, mandible, clavicle, ribs, and the pelvis may also be involved.[2, 3, 5]

In the early stages there may not be any symptoms present. As the tumor develops, there may be facial pains, neuralgic in character, and paresthesia of the lip.

The following two cases show a varied clinical picture and a definite disparity of the radiographic picture of the tumor. The lateral view of the mandible (Case 7, Fig. 7*B*) shows a diffuse involvement of the ramus simulating that of a low-grade ossifying osteomyelitis. In Case 8 (Fig. 8*A*) there is a marked widening of the inferior alveolar canal.

CASE 7.—M. K., White, male, aged 17 years. There was an early history of injuries to the mandible while playing ball. The patient fell at the age of 4 years. There was a scar on the left side of the face. There was no definite recollection of trauma to the affected area. The patient vaguely recalled that he had slight earaches during vigorous exercise.

In July, 1937, there was a sudden swelling intraorally and externally at the angle of the right mandible. The attending dentist refused to extract any teeth. Under conservative treatment, the swelling subsided but recurred in October of that year, when the patient reported to the New York University, College of Dentistry, Oral Surgery Clinic. There was a large swelling on the right mandibular ridge extending from the premolar area to, and including, the anterior border of the ramus (Fig. 7*A*). The mass was soft, mushy, and nonulcerated. The third molar was almost exfoliated. There was a hard, painless swelling buccally which extended to the ramus. A slight suggestion of cervical lymph node involvement was evident.

On Oct. 19, 1937, a biopsy (Fig. 7*C*) together with the removal of the lower right first, second, and third molars was done. The pathologic tissue report was "Ewing's tumor" (C. G. D.); "Ewing's tumor—endothelial myeloma" (Dr. James Ewing).

The patient was admitted to Montefiore Hospital on Nov. 12, 1937. On admission, there was a hard fixed mass on the bone above the angle of the right mandible in the ascending ramus, about 6 cm. in diameter. The mass extended anteriorly 7 cm. from the angle of the jaw on the horizontal portion of the right jaw. The upper right cervical nodes were slightly enlarged. The ones on the opposite side were also palpable. The cervical chain was shoddy right down to the supraclavicular region. There were no preauricular nodes.

Intraorally there was a swelling and a slightly ulcerated cauliflower-like mass, measuring 3½ cm. in diameter in the right molar region. This mass was on a somewhat lower level than the mass palpated externally. The tonsil on

Fig. 7*A*.—Clinical photograph of Ewing's tumor taken after the removal of teeth and showing an ulcerated cauliflower mass.

Fig. 7*B*.—Radiogram of the right mandible showing a diffuse radiolucent area involving the ramus of the mandible.

the right side was forced medially by the mass which appeared to extend behind it. The lungs were negative and there was no skeletal tenderness present.

The patient was treated with deep x-ray therapy. Shrinkage of the size of the mass occurred externally and intraorally.

On June 1, 1940, the patient was operated on at the Knickerbocker Hospital. A complete extirpation of the right mandible together with the adjacent soft parts, including segments of the masseter, pterygoid, mylohyoid, and a small edge of the superior constricter muscle, was performed. The patient was discharged from the Knickerbocker Hospital, June 21, 1940. He was readmitted to Montefiore Hospital, July 26, 1940, after having lost 20 pounds in weight. The patient was extremely weak and emaciated and showed multiple bony metastases. The patient died in September, 1940.

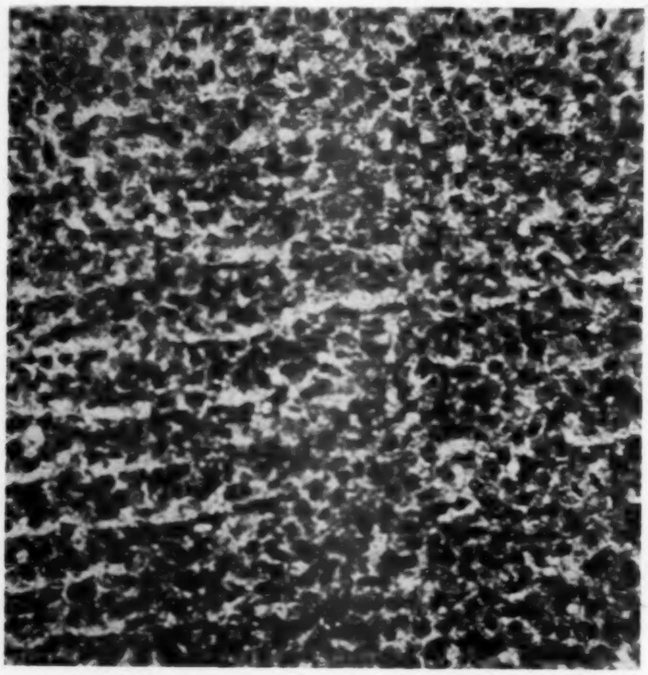

Fig. 7*C*.—Photomicrograph showing sheaths of myeloblasts.

Case 8.—G. R., white, female, aged 36 years. Following her pregnancy in 1938, the patient noticed numbness in the right mandible when sleeping on that side. This sensation of numbness would last only a few seconds after the pressure was relieved. About three months later, having pain in her right jaw the patient went to her dentist, who removed the lower right first molar tooth. This did not relieve her pain. She was referred by her dentist to an exodontist who removed the lower right second molar tooth and curetted an area below the second molar. Following this operation the patient felt a numbness of the right mandible. One month later she noticed a lump at the right mental region. She was again referred to the exodontist for operation. The patient was operated upon but no tissue was obtained for examination. Three months later the patient was referred to one of us (I. S.). A clinical examination revealed a definite

extraoral bulge, hard, at the lower right molar area, with paresthesia of the lower right lip and chin. Intraorally there was a bulge from the lower right second premolar to third molar area buccally. It was hard but not painful.

A lateral radiographic view (Fig. 8*A*) of the right mandible showed a radiolucent area in the first and second molar area and a marked widening of the inferior alveolar canal and mental foramen. A lateral view (Fig. 8*B*) of the left mandible revealed a normal width to the inferior alveolar canal and foramen.

Fig. 8*A*.—Radiogram of the right mandible showing a radiolucent area in the molar region where teeth had been removed. Note the marked widening of the inferior dental alveolar canal and compare this one with the canal on the left side which is normal in width.

Biopsy material was obtained from the lower right first molar area and from the contents of the inferior alveolar canal. The tissue was referred to one of us (C. G. D.) for examination and reported as a "Ewing's tumor" (Fig. 8*C*).

On June 16, 1939, the patient was admitted to Montefiore Hospital where another biopsy was made. Dr. D. Perla's report stated that the "slide does not permit a diagnosis but the appearance suggests some type of round-cell sarcoma, probably of the Ewing type." He requested another biopsy. This was then reported by him as a Ewing's tumor.

Clinical examination revealed palpable nodes in the neck and axillae. In the inguinal region, there were no nodes present. In the vaginal region, the cervix was somewhat enlarged and the uterus was enlarged to the size of a

Fig. 8*B*.—Radiogram of the left mandible showing the normal width of the inferior alveolar as compared with the radiogram of the right side.

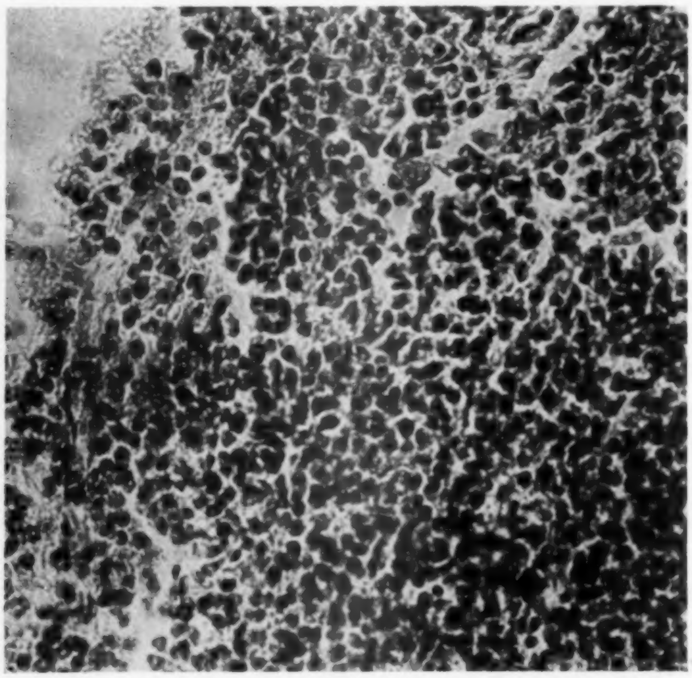

Fig. 8*C*.—Photomicrograph showing closely packed round cells with round nuclei and indistinct cytoplasm.

second-month pregnancy. The Kahn and Wassermann tests were negative. The patient was treated with x-ray therapy.

On March 20, 1940, there was some evidence of metastasis in several dorsal and lumbar vertebrae. Vaginal examination on May 6, 1940, showed a large mass adherent to the undersurface of the uterus and extending posteriorly to impinge on the rectum. There was pain present and a mass felt in the splenic region, in the uterus and ovaries, as well as in the right tonsillar and right axillary regions.

On July 5, 1940, a mass was felt in the upper right sternum. The patient died, Aug. 16, 1940.

The autopsy report showed: "Status post irradiation for Ewing's tumor involving the right mandible, left femur, and surrounding striated muscles, vertebrae (D-9), omentum peritoneum, fallopian tubes, suprarenals, lymph nodes of mesentery and retroperitoneal tissues." In addition there were the following diagnoses: "Recent infarct of spleen, hydro-ureters (bilateral), hydroperitoneum, hydrothorax (left), compression atelectasis of lower left lobe, tumor thrombosis of the splenic and renal views, and old endocarditis of mitral valve (rheumatic).

MULTIPLE MYELOMA

Multiple myeloma is a malignant disease of the bone marrow. Little is known as to its etiology. The disease produces an extensive involvement of the entire skeleton. The most frequently invaded bones are the ribs and sternum. Other bones, such as the skull and long bones, may be involved. Pain is the outstanding symptom and the disease is seldom recognized until it involves the entire skeleton. Bence-Jones albuminose in the urine is found in 60 to 70 per cent of the cases. Secondary anemia is due to a marked bone destruction. Frequent recurrences following high voltage x-ray therapy and occasional pathologic fractures may appear. Therefore, it is advisable for the patient to be under observation at frequent intervals.

The disease causes bone destruction and is a multiple lesion. The bones are pierced by small focal spots of destruction. The process does not expand or destroy the cortex. The cortex may be thinned out. Pathologic fractures are common. A correct diagnosis cannot always be made from the radiographic picture. The presence of Bence-Jones bodies together with the clinical examination will lead to a diagnosis of multiple myeloma.

The two case reports which follow have been diagnosed as multiple myeloma from lesions first discovered in the mandible.

Case 9.—M. U., white, male, aged 62 years. The patient had a loose lower right third molar removed without any anesthesia. This was followed by extreme bleeding which was difficult to control. Three months after the extraction, on June 16, 1939, the patient was referred to one of us (I. S.). The examination revealed at that time a soft large overgrowth on the ridge in the lower third molar region. It was about the size of a peach and was covered by mucous membrane. The lesion was bluish in color (Fig. 9*A*). There was no pain or

bleeding present. Radiograms (Fig. 9*B*) showed bone destruction in the lower right third molar area (1 by 1½ cm.).

The clinical diagnoses were: (1) Angioma of the mandible, and (2) giant-cell tumor of the central type. On June 20, 1939, using the endotherm knife, a biopsy was done. The histological examination of the tissue (Fig. 9*C*) revealed a "myeloma" (C. G. D.).

Fig. 9*A*.—Clinical photograph showing a mass in the right molar region.

Fig. 9*B*.—Radiogram showing a radiolucent area of the lower right molar region.

The patient was referred to the Outpatient Department of the Montefiore Hospital. Radiograms taken there showed multiplicity of bone lesions in chest, skull, pelvis, sternum, etc., with a suggestion of multiple myeloma or metastasis from an unknown primary lesion.

The patient received x-ray therapy to the various bone lesions and tumors. Some recession occurred. In November, 1939, he was admitted to the Montefiore Hospital after x-rays revealed that the chest showed considerable extension of the lesions.

The patient died on Jan. 30, 1940. An autopsy was performed and the following anatomical diagnoses were given: Multiple myeloma involving right mandible, ribs, sternum, skull, and pelvis, left pleura, capsule of the right kidney, and scattered lymph nodes. Collapse of the twelfth dorsal vertebra. Chronic nephrosis. Atherosclerosis of coronary arteries with marked narrowing of the lumen. Hypertrophy of the heart.

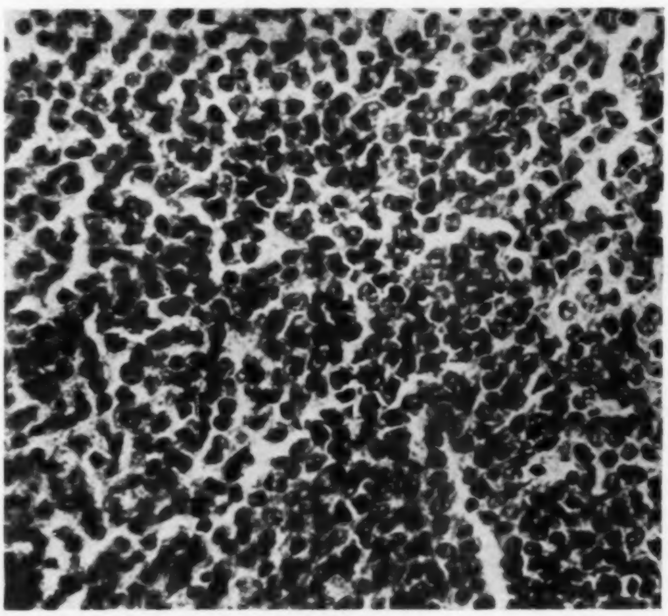

Fig. 9*C*.—Photomicrograph showing plasmalike cells with no stromal tissue support.

CASE 10.—C. G., white, female, aged 51 years.—On June 4, 1940, the patient was referred to the New York University, College of Dentistry, Dental Clinic, with pain at the inferior border of the mandible. Lateral view radiograms (Fig. 10*A*) revealed two cystic areas in the molar region and the ramus. During the operation the tissue removed resembled a degenerated cyst. The involved area was very vascular. The pathologic tissue (Fig. 10*C*) report was "myeloma" (C. G. D.).

Radiographic examination of the left mandible showed numerous small round areas of destruction throughout the body (Fig. 10*B*) of the mandible. The lateral view of the skull (Fig. 10*D*) revealed metastatic involvement.

Our records showed that on Sept. 5, 1940, the patient was admitted to the Hackensack Hospital, where radiograms of the chest revealed metastatic lesions bilaterally in the lower ribs. The patient received x-ray therapy, but no other follow-up data are available.

Fig. 10*A*.—Radiogram of the right mandible showing areas of radiolucency.

Fig. 10*B*.—Radiogram of left mandible of patient with multiple myeloma showing numerous areas of involvement of the mandible.

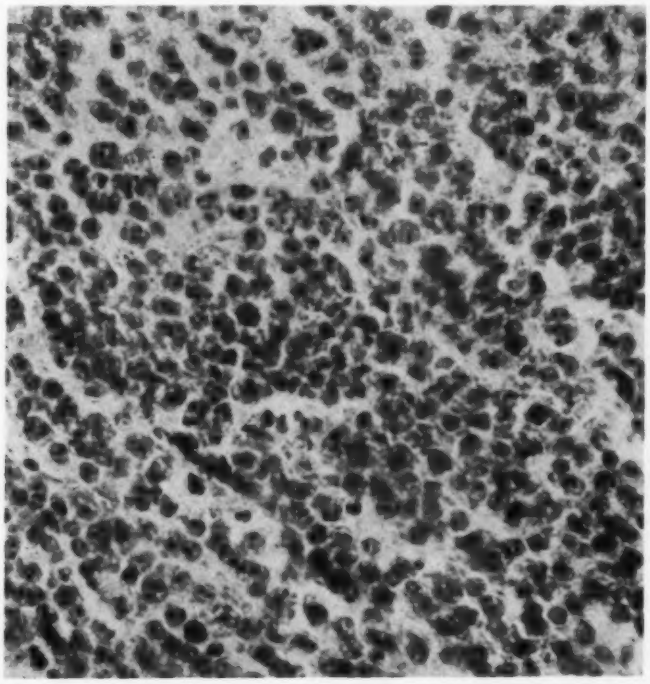

Fig. 10*C*.—Photomicrograph showing mononuclear cells which are slightly larger than lymphocytes.

Fig. 10*D*.—Radiogram of the skull showing metastatic involvement.

KAPOSI'S SARCOMA

Although Kaposi's sarcoma is seen rather frequently in certain localities, as in New York City, it is a rare disease. Many writers[10-12] believe it is most common in the Hebrew race. MacKee and Cipollaro[8] believe the disease to be geographic rather than racial. It is also called by them idiopathic multiple hemorrhagic sarcoma. It is more common in men than in women and can be found in all age groups. The duration of the malady varies from eight months to twenty-five years. There are a few cases on record where spontaneous recovery occurred after a ten-year period.

Fig. 114.—Clinical photograph showing Kaposi lesions on the foot (diagnosis at Bellevue Hospital, New York).

Clinically, the disease is characterized at first by small nodules, discrete or crowded together, which are about pea-sized and are found in the skin or subcutaneous tissues. These nodules are somewhat elevated and painful at times. The color varies from a reddish blue to a purplish or even blackish blue and can be seen on the lower extremities. In some cases, instead of distinct tumor formation, there is a conglomeration forming large infiltrated areas. Occasionally the growths appear suggestive of angiomas. Ulceration is uncommon.

While there is a distinct predilection for the lesions to be present first upon the extremities, it can involve any body surface. When the disease is well advanced, the mucous membranes are involved and, according to autopsy reports, the visceral organs sooner or later become involved also. Lesions of the mucous membrane of the mouth, however, have been rarely mentioned. Death occurs by some associated disease; more often by prolonged, progressive wasting, and emaciation caused by visceral involvement.

Case 11.—S. G., white, male, Hebrew, aged 59 years.—The patient was admitted to Montefiore Hospital, March 22, 1939, complaining of nocturnal dyspnea, orthopnea, and fatigue.

From the past history it was noted that in 1933 the patient was treated at various times at the Post Graduate Hospital, in 1936 and 1938 at Bellevue Hospital, and in 1938 at Lincoln and Lebanon Hospitals. He had been treated, among other things, for hypertensive arteriosclerotic heart disease, rheumatoid arthritis, and syphilis.

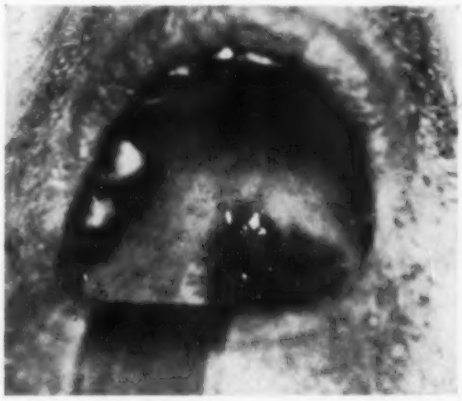

Fig. 11*B*.—Clinical photograph showing Kaposi lesion in the palate.

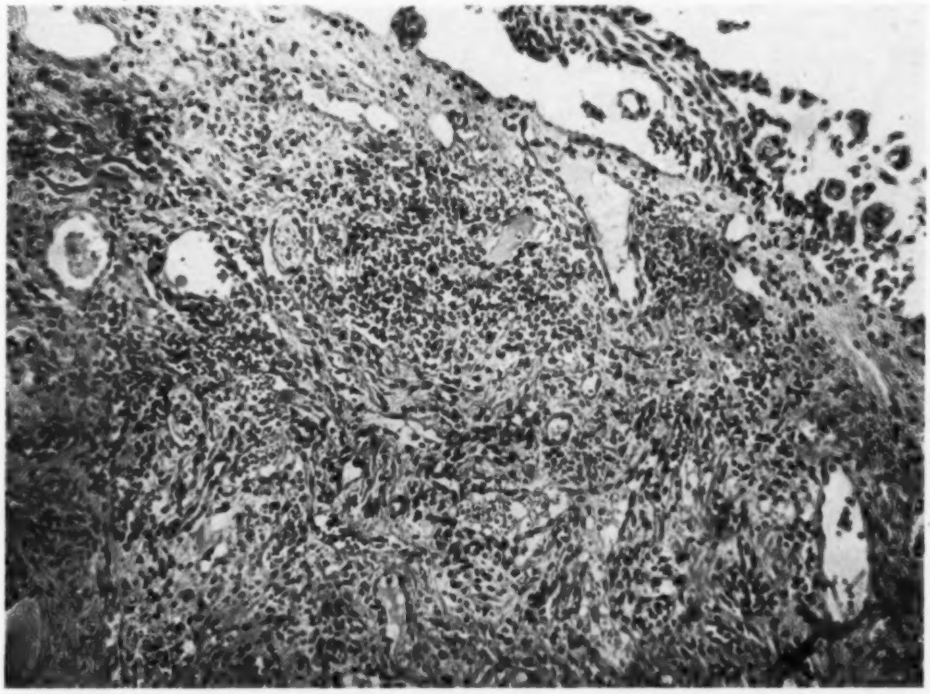

Fig. 11*C*.—Photomicrograph showing angiomatous proliferations and infiltrations of large mononuclear cells. Mitotic figures are rare.

For the past eight years the patient has had purplish patches on the lateral aspect of both feet (Fig. 11*A*). The lesions were not raised or painful. A diagnosis of Kaposi's sarcoma was made at Bellevue Hospital. X-ray therapy was given, and the lesion responded well to the treatment.

In April, 1939, a dental examination revealed the presence of a few teeth in very poor condition. The tongue was somewhat smooth along the edges. A flat, purplish-red lesion was present (Fig. 11*B*) across the soft palate, about 1 by ½ inch in size. The lesion, though it had somewhat the appearance of an

Fig. 11*D*.—Clinical photograph of palate following irradiation therapy. Complete healing of the Kaposi lesion has taken place.

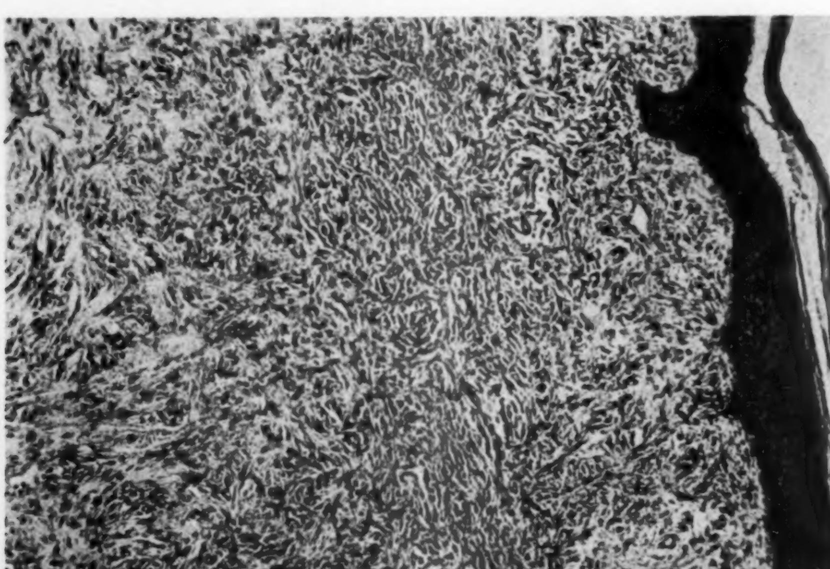

Fig. 11*E*.—Photomicrograph of section from lesion on the foot (seen in Fig. 11*A*).

angioma, did not appear raised. The clinical diagnoses of the oral lesion were: Angioma and idiopathic hemorrhagic sarcoma. The pathologic tissue report (Fig. 11*C*) of the biopsy was "telangiectasis" (Dr. D. P.). The palatal lesion disappeared following x-ray therapy (Fig. 11*D*).

On May 5, 1939, the patient was presented at a meeting of the Bronx Dermatological Society. All those present agreed that the palatal lesion as well as the lesions on the extremities were Kaposi's sarcoma. A review of the biopsy slide from the tissue of the foot (Fig. 11*E*) was made by the late Dr. Satenstein of the New York Skin and Cancer Hospital where the diagnosis also had been Kaposi's sarcoma. In November, 1940, the patient was attending the Skin and Cancer Hospital where he received local treatment through Dec. 9, 1940. There was no change in his condition. No further data of this case are available.

In presenting these cases of rare tumors of the jaws, we wish to thank the following: Dr. L. Winter, Professor of Oral Surgery of the New York University, College of Dentistry; Dr. D. Marine, Chief of the Pathology Department, and Dr. D. Tanchester, Chief of the Dental Department of Montefiore Hospital for the source of the material.

To Dr. O. Miller and the late Dr. L. L. Lefkowitz of the Pathology Department of New York University, College of Dentistry, we are especially indebted for their aid in the preparation of these cases.

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DENTAL CONTRIBUTIONS TO OTOLOGY

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IT WOULD require no special effort to validate the premise that medicine and dentistry are intimately related. In the pursuit of the respective professions, there is definite overlapping and complementation of function, diagnosis, therapeutics, surgery, rehabilitation, and so forth. If anything, particularly within the sphere of the head, the dentist is more likely to contribute or step over into the field of medicine as a measure of requested necessity because of his specialized technical talents and basic services essential to proper medical attainment.

Dental interest in the field of otology, from the purely clinical aspects, is well known; and, vice versa, the etiological possibilities of dental dysfunctions are of concern to the otologist. Deafness and reflex symptoms are two typical focal points of both professions.

As might be expected, however, in both fields there is limited knowledge of information that can be of mutual service. The dentist should familiarize himself with an otological diagnostic or testing adjunct, the audiometer, for with an understanding of its use, it may well serve as reasonable record and check of his treated patient. In an equal sense the otologist ought be familiar with the contributions of the dentist, as a natural expression of his particular qualifications in complementing the otologist's efforts in rehabilitating the deafened patient through the optimum use of a hearing aid.

The audiometer is an instrument capable of producing pure tones, in octave or semioctave steps, or in a continuous band of frequencies, with control as to the intensity of each tone as it is produced. Tone intensity is recorded in terms of decibels, an acoustical unit of measure. When a patient is under examination, he is subjected to select test tones or frequencies, and a record of the lowest intensity he is able to hear is made on a chart. Connecting the noted intensity point of each tone or frequency results in a graph or audiogram which presumably represents a picture of what the *patient does not hear.*

The advantage of the audiometric examination over the tuning fork or other means is that it permits a relative accuracy and consistency for re-examination. As a clinical aid, it has considerable virtues to recommend its use. On the other hand, as a scientific instrument, it is still inadequate. To the dentist or specialist involved in studies of auditory deficiencies or disturbances of one nature or another through the vertical dimension (anterior or posterior), re-establishment of occlusal relations, repositioning of temporomandibular articulation or the mandible—the audiometer can be of material assistance in recording responses before, during, and after treatment. Audiometric readings are over-all recordings of middle and inner ear, and not as differential diagnostically as the tuning fork. Yet they help in considerable extent to determine the types and degree of deafness. With sufficient clinical data and case history, the dentist is in a

better position to orient the probables from the improbables; the audiogram will very likely show an appreciable gain on subsequent audiometric tests. A typically cautious point, however, would be in order. *It is entirely possible to obtain a favorable reaction in a patient through dental intervention by re-establishment of maxillo-mandibular relationships, and still fail to obtain an audiometric reading of sufficient gain over previous records to substantiate an apparent improvement.* This is an issue that is best left for further study by the otologist, physicist, and acoustic engineer.

The subject of audiometry can be pursued advantageously by the serious dental student through many otological and acoustical books and periodicals.

Recently, a monograph, *Clinical Audiometry*, by the late C. C. Bunch, has been published, which warrants more than passing interest. It is descriptively offered to the dental profession as reflecting the "rich background of the author in research and experience, and with the technique, suggestions and recommendations evolved from years of study." Dr. Bunch was not a Doctor of Medicine specializing in otology, but rather a Doctor of Philosophy who has had affiliations either as an associate or professor in otology in medical colleges of high standard.

The book is interesting, informative, and may prove of some worth as an introduction, for the uninitiated, into the field of audiometry. There is no desire to review the book as a whole, or to give its place in scientific or otological literature. Nor am I interested in refuting the author's contentions on the use of an audiometer as an instrument for the proper fitting of a hearing aid, in spite of my own experience which is fairly well known, and a number of papers which tend to refute Bunch's assumptions which were presented at the recent meeting of the Acoustical Society of America.

Reading the title page, one inferentially accords the author a degree of authenticity. It is with this that I am particularly concerned, since he renders information which is within the realm of the dentist, and which can readily be questioned. Additionally, and lamentably, he opiniates disparagingly of the profession, which ought not to remain uncorrected and unchallenged.

For the purpose of orientation, some simple fundamentals must be understood. It is assumed, and so advanced by Bunch, that when a person has arrived at the stage where he needs a hearing aid, the otologist can chart his deficiency by the use of an audiometer. Then an instrument is selected which presumably has the ability to amplify those tones which will match the patient's hearing deficiencies. *It is not so simple.* The catch is, that for the deafened ear, there is quite a gap between the sound that comes out of the end of a midget receiver and that which will be received at the tympanum or middle ear structures to transmit on to the brain. The sound must run through the length, breadth, and forms of the external auditory meatus. To bridge this gap—the meatus or auditory canal—it is essential that a properly made individually molded earpiece be used to hold the midget receiver constant and to transmit the sound from the instrument to the tympanum or middle ear structures.

With the foregoing in mind, we can consider a quotation from Bunch: "The modern vacuum tube hearing aids are usually equipped with small telephone receivers which are held in place by nonirritating plastic molds. These

molds must be fitted accurately in the concha and external canal or sound will leak around them, feed back into the microphone, and set up distracting howls. The preparation of the preliminary model, usually plaster of Paris, *requires considerable care* and some knowledge of anatomy. . . . Since the final *mold is held in place by friction,* it should extend well into the canal. . . . *The canal* and parts of the external ear which come in contact with the plaster of Paris are *coated with vaseline* or oil to prevent it from sticking. The plaster is the kind commonly used for dental impressions, *it is quick setting, will not heat enough to burn the ear, and flows easily without forming bubbles* . . . the patient's head is placed so that the *plaster can be poured into the canal.*

"It seems wise that all steps in the preparation of the plaster pattern should be done under the supervision of the otologist. He knows the anatomy of the ear, can clean the canal without trauma, and *is protected by law should an accident occur. Dentists and even office assistants are known to be doing this work and as a consequence accidents resulting in suits have been reported.*" (Italics not in original.)

To the dentist, the foregoing quotation leads to an inevitable conclusion. Bunch may have had considerable experience with audiometrics, but as to the art and science of auditory prosthesis it does appear his endeavors must have been either peculiarly limited or subject to limited observations, and so questionably positioned for rendering opinion.

Perhaps it is best that these inaccuracies and disparagements be corrected with factual presentation. A personal experience of more than twenty years in this phase of the problem of deafness permits of a certain authoritative opinion.

It is true that plaster must be mixed carefully, and that some knowledge of anatomy must be possessed. Certain it is, that a dentist would have far more knowledge and experience in the handling of impression materials than any otologist; and as for the limited anatomy, it is most readily within the scope of his studies and understanding. That one should be deft of hand is conceded as an attribute; yet a greater skill is required in a subgingival curettage or the removal of a fractured root treacherously close to the antrum, than in taking an impression of the external auditory meatus.

The truth of the matter is that nothing has ever been offered by the medical or otological confreres with respect to impression or ear-fitting techniques, that has not been of dental or dental commercial origin.

The point is well stated that accurate fitting is essential, but inaccurate is the suggestion that vaseline be used to prevent the plaster from sticking to the ear. With the exception of the occasional ear or canal filled with hair, and then it is readily overcome, no difficulty is encountered through adhesion of plaster. A very light-bodied oil, thinly coated over the tissues, is more than adequate. The use of vaseline is very definitely contraindicated. It repels plaster, creates voids, pockets, and blurring of tissue, and precludes an accurate impression so essential as a prime for a well-fitting earpiece.

The suggested use of a quick-setting plaster, since it will not burn the ear, is difficult to comprehend. Quick-setting plaster *should not be used,* since in the hands of the average operator it sets too fast to handle in most ears for completeness and accuracy of impresssion. That our slower-setting or decelerated plasters burn the ear is a groundless caution.

Plaster should never be poured into the ear. When a mix is made so thin as to run so easily, then trouble can ensue because the set plaster will have "weak body" or solidity. When plaster is properly mixed and poured into the auricle, air is bound to be trapped, resulting in bubbles and voids in the cymba conchae, between the crus and crura, and in the auditory canal proper.

The question of legal responsibility is interesting. Since when does the law protect any professional, matter not the pursuit, from any claim of the layman, right or wrong? One of the worst experiences I have heard occurred to a physician and under medical supervision in the taking of an impression of the ear.

The disparaging reference to the dentist and his assistant is something I have tried over and again to fathom. I can appreciate a brief in behalf of the otologist and his claim to supervisory capacities. But arguments are not clinched by the presentation of statements which are inconsistent with very commonly known facts.

We might concede for the sake of discussion that taking an impression of the ear and making an earpiece is not practicing dentistry—but is it practicing medicine? Have not dentists made and do they not continue to make artificial substitutes for lost facial segments in complementation of the medical surgeon? In the unfortunate prevailing hostilities is not the dentist a vitally important member of the plastic surgery team? Only recently, at the New York State Dental Meeting, Capt. C. R. Wells, (D.C.) U.S.N.R., President of the American Dental Association, reported that dentists were helping in rehabilitation work because of their knowledge of plastics in the reconstruction of artificial fingers, eyes, etc.

One need but check with innumerable institutions to learn of the complemental contributions of the dental members following major resections other than oral.

As this is being completed, there appears an interesting and timely article by Stanley D. Tylman, Professor of Prosthetics in the College of Dentistry of the University of Illinois.* It deals with resilient and elastic resins in maxillofacial prosthesis, and very pertinently details the ear. Though the article includes a considerable number of references in dental literature of collateral interest, Tylman very succinctly qualifies the position of the dentist in his prefatory "digest," and merits quotation.

"The dentist is well qualified to construct prosthetic appliances for the face and head because of his technical skill and familiarity with the materials used, and his knowledge and training in the biologic sciences. This field of service is opening wider for him with the increase in the number of people demanding prosthetic treatment as the result of both civilian and wartime casualties."

To the closing thought of the foregoing can be added the all too evident truth of the necessity of such competent dental services for the thousands upon thousands of servicemen whose hearing will have been impaired and the civilian thousands who are victims of progressive deafness beyond otological therapeutics.

*Tylman, S. D.: Resilient Resins: Technique for Their Use in Maxillofacial Prosthesis, D. Digest 50: 260, 1944.

It so happens, that it was through the pleasurable request of the late eminent Dr. Max Goldstein, Editor of the *Laryngoscope,* that an article was prepared on the subject of earpieces and was published in the January, 1941, issue. The *Laryngoscope* is an international monthly journal devoted to diseases of the ear, nose, and throat. It is the official organ of the American Otological Society and at least three other otolaryngological organizations. Dr. Bunch, as assistant to Dr. Goldstein, handled the manuscript. He immediately took exception to the original title which included the wording "auditory prosthesis." He seemed to feel that it might be misleading since it had a specific otological import. He offered as evidence of prosthesis, a little ingenious device developed by Dr. Pohlman, an eminent otologist, which is inserted within the ear in certain cases of deafness, and which apparently gave results. The illuminating story is that it was a dentist who made the device for Dr. Pohlman. The article was finally published under the significant title, "The Earpiece—in Testing for and Fitting Hearing Aids,"* and represents, perhaps, the first wholly original article of such nature.

There is another, and very interesting situation, which is all too commonly known. *There are probably thirty to forty times as many lay people*—hearing aid salesmen and saleswomen, without medical or dental background of any kind—*taking impressions of the ear, hundreds of times per week, as there are combined otologists and dentists.*

To prolong refutation would tend to wearily belabor the issue. Suffice to say, the original premise still prevails, i.e., the interchange of information and services between dentistry and otology has been, and can be, of mutual advantage. The dental contributions are ever so many, and even though this writer with humility admits to a considerable hand in them, their very fundamental truths and usefulness have become so obviously mandatory in practice as to need no other authentication than bare summarization.

Briefly and incompletely, here are some of these contributions, which as basic concepts have influenced and will govern the rehabilitative phases of otology, the proper fitting of a hearing aid for the deafened patient:

1. The establishment of a proper impression technique to assure reproduction of the auricle and meatus at rest, completely, accurately, and with safety.

2. The first manual on the subject of impressions and ear prosthesis to be published, and later to become a requisite for malpractice insurance.

3. The basic concept that stock molded earpieces are inadequate; and initiating the introduction of the individually fitted earpiece as a necessity for use with every air conduction hearing aid.

4. The demonstrative proof that bone conduction was exploited beyond its limited use and was only possible because of inadequate air conduction fitting.

5. Publication of an article in *Dental Items of Interest* "Auditory Prosthesis," accredited as the most comprehensive presentation of the problems of the ear, and subsequently delivered by request before the Greater New York December Meeting in 1933.

6. The first motion picture film on auditory prosthesis, which was exhibited throughout the United States, and later included by Dr. E. P. Fowler, Jr.,

*Schier, M. B. A.: Laryngoscope 51: 52, 1941.

Assistant Professor of Otology at the College of Physicians and Surgeons, Columbia University, in his own film, "The Otologist's Responsibility in the Fitting of Hearing Aids." This latter film was presented before the triotological Meeting in Chicago in 1941, and subsequently at Columbia University under the auspices of the Department of Otology. Dr. Fowler's introductory remarks were expressive of his indebtedness to the dentist for the basic approach to the ear.

7. The acrylic earpiece now universally used is the result of dental development and introduction. In 1937, in national plastic competition, an especially difficult molded piece of the pure polymer won a Scientific Award. This is perhaps particularly significant in that it is likely the first award made to a dentist. The moulding was done in calcined gypsum or artificial stone solely of the plain polymer, not the monomer-polymer mixture, and through the use of an especially devised injection flask antedating such of similar design now available.

8. The enunciation of fundamentals and practice involved in the use of an earpiece for the transmission of sound; and the variations in sound which may be produced affecting the hearing aid characteristics and ear receptivity. This has now proven so important as to become a focus of very considerable attention by acoustic engineers, physicists, and by our government through special project studies instituted by the National Research Council.

110 East 42nd Street

EXTRAORAL INFRAORBITAL NEURECTOMY IN TRIFACIAL NEURALGIA

L. T. Russell, Jr., D.D.S., Murphy, N. C.

In considering the anatomic features and pathologic possibilities in performing infraorbital nerve resection, especially with infection present in the mouth, I have had gratifying results, practically no scarring, and peace of mind in performing the operation through an extraoral incision. I do not propose that the technique as given in this paper is original; however, all the literature I have studied on the subject advocates access to the infraorbital nerves through the oral route. The intraoral technique is a splendid method, and it is not the purpose of this paper to criticize or condemn its use.

The technique which I describe here involves only the principles of aseptic surgery combined with a thorough knowledge of anatomic detail. It has advantages and disadvantages, which I will discuss and endeavor to explain.

First, the advantages: The possibility of infection is considerably reduced by an extraoral method, because a more rigid aseptic technique can be followed; we can operate in a "clean" field, thus proportionately reducing the possibility of cavernous sinus thrombosis, septic meningitis, or both. We cannot be reminded too often that the veins of the upper face have no valves; and we must keep in mind that they pass into the great sinuses within the brain case before returning to the heart.

Another advantage is that we have clearer visibility and easier access to the nerve and its branches. There is no necessity for special lighting, mouth gags, suction apparatus, or throat packs, which are always essential in oral operations of any type. The only instruments necessary for the extraoral operation are included in the setup of an ordinary dissection tray. This setup has usually two scalpels, small and large hemostats, scissors, and Allis clamps.

The only disadvantage which comes to my mind in this operation is that a visible scar will be produced. The amount of scarring or visible defect will depend largely on the surgeon. With a clean-cut incision, closely and accurately approximated edges using fine sutures, the visible defect will be negligible.

One thing which is not a disadvantage, but which cannot be stressed too emphatically, is to avoid severing the inferior palpebral branch of the facial nerve. The cutting of this nerve results in ptosis of the lower eyelid with probable, and subsequent conjunctivitis.

The simple technique described here is presented to you with the hope that it will be of value in relieving, for a time at least, the most severe of all pain, trifacial neuralgia. The operation is performed in the hospital with strict aseptic precautions. Ether is the choice of anesthetics.

TECHNIQUE

The incision begins at a point on an imaginary vertical line drawn through the medial commissure of the eye at the level of the infraorbital foramen, and extends laterally in a curve, parallel to the inferior border of the orbit, ending at a point on an imaginary vertical line through the lateral commissure of the eye. Due to the curve of the inferior border of the orbit, the incision will run slightly below the foramen. (Fig. 1.)

The initial incision is made through the skin down to, or through a part of the orbicularis oculi muscle, to be followed by careful dissection through the upper portion of the quadratus labii superioris muscle and through the periosteum to the bone.

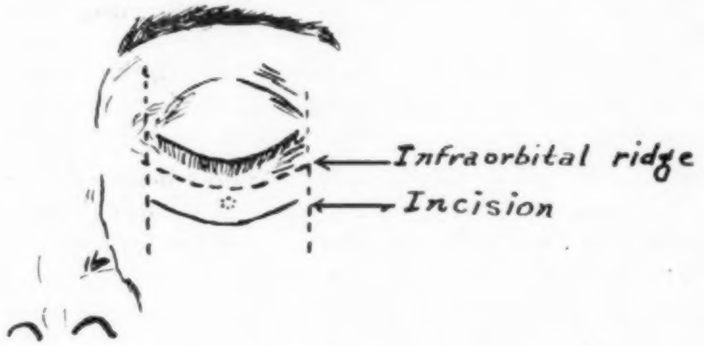

Fig. 1.

The periosteum is carefully dissected upward or elevated by a small blunt instrument, which will pull the infraorbital nerves and vessels slightly from the foramen where they can easily be seen, even though the distal portions might have been severed previously by the incision.

After having thus exposed the nerve in question, it is grasped with a strong hemostatic forceps, and with gradual traction and a slight alternate twisting motion the nerve is pulled out and another hold is taken closer to the foramen. This procedure is repeated until the nerve trunk breaks. (Duration of the period of relief is proportionate to the amount of nerve tissue removed.) We then grasp the distal portion of the nerve and, by blunt dissection, seek out and remove as much as possible of the lateral nasal and superior labial branches.

The incision is closed in the following manner: the periosteum is returned to position and left unsutured; the muscles are sutured with plain catgut, and the skin edges united with fine silk. Any necessary ligation of vessels should be carried out as the operation progresses, for obvious reasons. The severing of blood vessels in this area will not greatly interfere with circulation, as there are numerous anastomosing branches which form a complete vascular ring around the orbit.

A small sterile dressing of gauze soaked in boric acid is applied to cover the eye on the side operated on. Skin sutures are removed on the third or fourth day and the wound left exposed to the air.

DIABETES IN RELATION TO CERTAIN ORAL AND SYSTEMIC PROBLEMS

PART II

A HISTOLOGIC STUDY OF THE GINGIVAE AND ORAL MUCOUS MEMBRANES: (1) IN JUVENILE DIABETICS, (2) IN INSULIN-TREATED AND DIET-CONTROLLED ADULT DIABETICS, (3) IN INSULIN-TREATED NORMAL MONKEYS

DANIEL E. ZISKIN, D.D.S.,* WINIFRED C. LOUGHLIN, M.D.,† AND ELI H. SIEGEL, SC.B., D.D.S.‡

PART I of this report described the gross gingival findings of eighty-one white children attending a summer camp of the New York Diabetes Association. In that phase of the study, the gums were seen clinically to deviate from the normal pink color, assuming varying intensities of a violet color in the majority of cases. The gingivae also appeared thicker than normal. The general prevalence of these conditions gave rise to the question of etiology, and a histological study was undertaken with a view to determine whether or not certain gingival changes could be attributed to the diabetic state. Data pertaining to this problem are reported here.

This study deals with the gingival changes seen microscopically in a group of diabetic children residing in New York City and attending the summer camp of the New York Diabetes Association, and diabetic children and adults attending the Columbia University-Presbyterian Hospital Medical Center. In all, fourteen children, a random selection (aged 4 to 14 years), five insulin-treated adults (aged 22 to 63 years), and two diet-controlled diabetic women (aged 42 and 57 years) constitute the series of human subjects. (Table I.) Four female rhesus monkeys comprise the animal group.

METHODS

In the human beings, tissue was taken for biopsy purposes after they had been under treatment for varying lengths of time. Gingival sections were similarly prepared from selected normals (children and adults) and from normals used in other studies. In the animals, pre-experimental and post-treatment biopsies were made.

Preparation for microscopic examinations was as follows: Under local anesthesia (without previous preparation of tissues for purposes of sterilization), two vertical parallel incisions were made, one on either side of an interdental papilla. The incisions were carried well onto the mucous membrane, in most instances to the mucobuccal fold. The flap of tissue was dissected from the bone and cut off near the mucobuccal fold. One or two dermal sutures

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Aided by a grant from the Research Fund of the New York Diabetes Association, Inc.

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TABLE I

HUMAN GROUP ON WHOM GINGIVAL BIOPSIES WERE MADE

CASE	SEX	AGE (YEARS)	DURATION (YEARS)	DAILY INSULIN DOSAGE (UNITS)	CONTROL TYPE	VIOLET COLOR	THICKENED	REMARKS
1, E. S.	M	4	3	15	Fair	++	++	
2, A. C.	M	5	1	10	Fair	++	+	Race, black
3, W. G.	M	5	2	20	Good	++	+	
4, L. T.	M	10	10	30	Fair	+++	++	
5, K. B.	M	10	1	25	Fair	+++	++	Local marginal inflammation
6, C. D.	F	11	6	50	Good	+++	+++	
7, E. P.	M	11	10	21	Fair	+++	++	
8, F. F.	M	11	7	40	Fair	++++	++	
9, J. K.	F	12	2	20	Fair	+++	++	
10, M. G.	F	12	1	4	Good	++++	++	
11, A. G.	M	12	6	30	Good	++++	++	Local marginal inflammation
12, D. C.	F	13	11	40	Fair	+++	++	Local marginal inflammation
13, R. G.	M	13	2	30	Fair	++++	++	
14, M. M.	F	14	2	34	Good	+++	++	
15, F. R.	F	22	12	82	Fair	++++	++	Subacute Vincent's infection
16, F. C.	F	27	3	93	Poor	++	++	Gingival proliferations
17, L. K.	M	28	15	40	Poor	+++	++	
18, D. K.	F	42	3	60	Fair	+++	++	Nonsuppurative advanced periodontoclasia
19, A. F.	F	63	11	40	Fair	++++		Edentulous
20, S. M.	F	42	7	None	Fair	±	±	Gingival abscess
21, A. M.	F	57	4 mo.	None	Good	±	±	

were placed in order to draw together the edges of the loose tissue. The space from which the section was removed was protected by the blood clot formed.*

The surface of the excised papilla was sponged dry with a piece of gauze and divided in half vertically. One-half was immediately immersed in Zenker's solution. After six hours of fixation, the tissue was cleared in the usual way, embedded in paraffin, and sectioned. The other half of the tissue was fixed in Vestrini-Cresi fixative.† The Zenker-fixed tissue was stained with hematoxylin and eosin, Masson's trichrome, Mayer's mucicarmine and Weigert's elastic tissue stain. The Vestrini-Cresi fixed tissue was stained with Best's carmine stain for glycogen. Some of the tissue was fixed in formalin, and osmic acid stain for fat was made.

FINDINGS IN GINGIVAE OF INSULIN-TREATED CASES

The following is a description of the typical histological findings in the insulin-treated human beings. The entire tissue, both epithelium and connec-

*The method here described for taking gingival sections has been used successfully by us in hundreds of cases. There is little discomfort to the patient, healing is rapid, and no disfigurement results. We have used this method on patients with a variety of systemic disorders, and, ordinary caution having been observed in selection, we have had no untoward experiences.

†Vestrini-Cresi fixation for glycogen: 95 per cent alcohol, 100 c.c.; formol 40 per cent, 10 c.c.; glacial acetic acid, 5 c.c. Fix for 6 hours, not more than 24 hours. 95 per cent alcohol for 6 to 12 hours. Absolute alcohol from 4 to 6 hours.

tive tissue, was enlarged owing to hyperplasia (Figs. 1 and 2). The tissue stained brightly and uniformly with eosin, giving the general appearance of firmness and health.

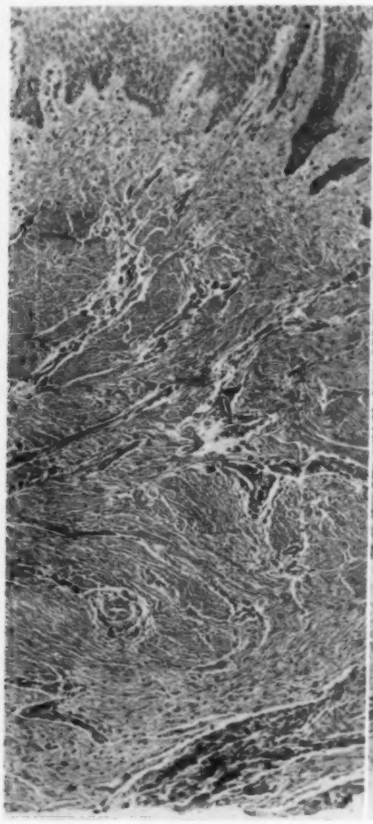

Fig. 1.

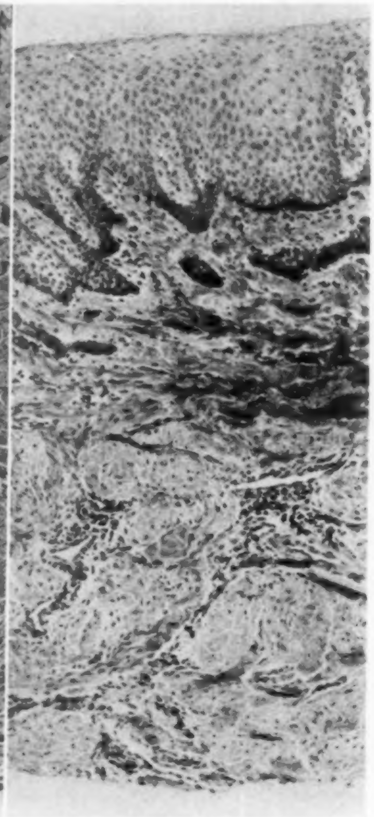

Fig. 2.

Fig. 1.—Female, white, aged 10 years. Duration of diabetes: Seven years. No other abnormalities. Insulin dosage: 20 units protamine plus 20 units regular. Food intake: 1,705 calories. Control poor. Section of upper left second incisor papilla, alveolar gingiva. Magnification ×125. Shows hyperplastic epithelium and enlargement of the connective tissue especially, which accounts for the increase in thickness of the gingivae seen clinically. Compare with normal tissue (Fig. 2).

Fig. 2.—Female, white, aged 8 years. Upper left second incisor papilla, alveolar gingiva. Magnification ×125. Shows the gingivae of a normal girl for comparison with Fig. 1. Subject was unusually large for her age and in good health.

Epithelium.—There was hyperkeratosis present, more marked in the alveolar gingivae than in the areolar.* In the latter, the mature keratin was seen in a broken layer. A number of flattened cells near the surface, with pyknotic nuclei, indicated immature keratinization in this area. The stratum granulosum in the alveolar gingivae was scarcely in evidence. There were a few keratohyaline granules present, but nothing like a normal layer. None were present in the areolar gingivae. A marked increase of coarse basophilic staining granules was prominent in the areolar gingivae. They were sprinkled through the cytoplasm below the level where keratohyaline granules are ordinarily found, being situated at the middle of the tissue and extending into the

*The loosely attached gingival mucous membrane which is continuous with the buccal mucosa. (See Figs. 17 and 18.)

stratum germinativum almost to the basal layer. Their appearance resembles cytoplasmic dust or sand. Their significance is unknown. These granules are not marked in the alveolar gingivae.

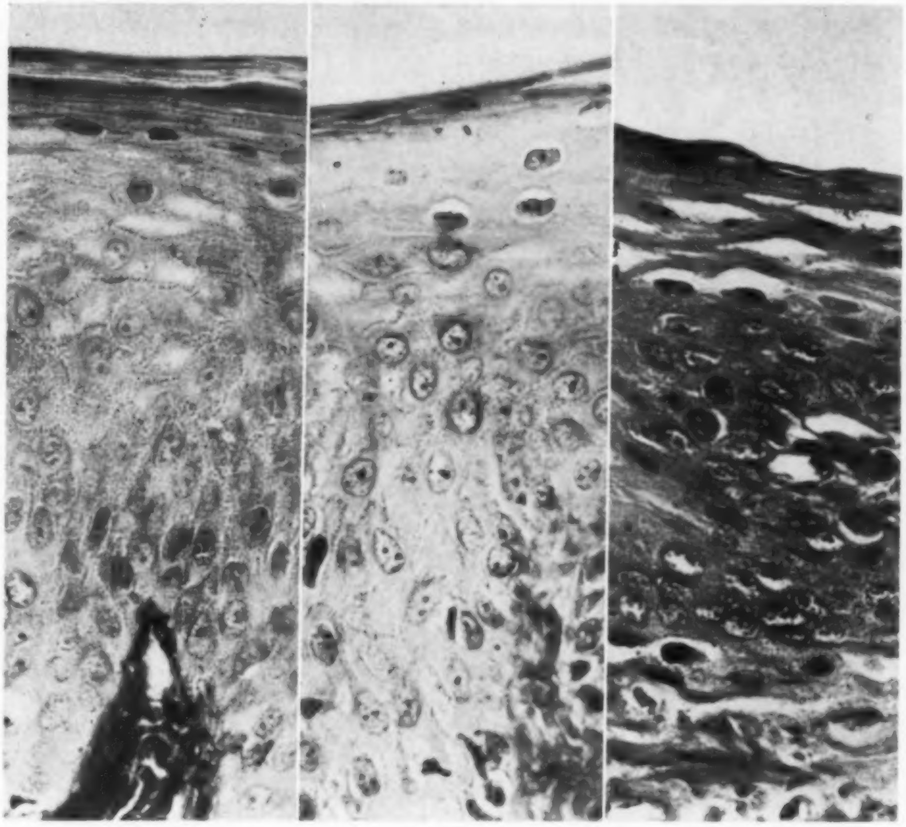

Fig. 3. Fig. 4. Fig. 5.

Fig. 3.—Same case as in Fig. 1. Magnification ×850. Shows increased thickness of keratin layer and large, even-sized prickle cells with prominent intercellular bridges. Compare with normal tissue in Fig. 4.

Fig. 4.—Same case as in Fig. 2. Magnification ×850. For comparison with Fig. 3.

Fig. 5.—Same case as in Fig. 1. Magnification ×850. Shows areolar gingiva with layer of keratin on surface. None is seen in normal tissue.

The intercellular bridges were prominent throughout the alveolar gingivae and the stratum germinativum of the areolar gingivae. The prickle cells were large with large vesicular nuclei in their centers. The nuclear membranes were prominent. Two or more nucleoli were not unusual. Perinuclear vacuoles were seen. These corresponded in location to the red-staining glycogen granules observed in this tissue with the Best's carmine stain for glycogen. The basal cell layer was crowded with nuclei, emphasizing the hyperplasia present. These nuclei were comparable in size to the prickle cell nuclei, but more oval in shape. Mitosis was not increased. The epithelial peg pattern was normal in the alveolar gingivae and flattened in the areolar (Figs. 3, 4, and 5).

Connective Tissue.—The papillae of the corium were seen to lie closer to the surface than normally. The corium appeared increased in thickness and

of a homogeneous pattern. Thick-bundled interwoven collagenous fibers were in close apposition. An increased prominence of the capillary bed was noted throughout this layer, especially in the small capillaries which showed large endothelial cell linings. Densely stained fibrocytes were scattered among the collagenous bundles but large vesicular fibroblasts were more prominent (Fig. 6). The whole tissue appeared hyperplastic. Inflammatory exudate was either absent or slight in most cases. In those instances where marked inflammatory areas were seen, the amount of inflammation was less than would be expected from the gross pathology.

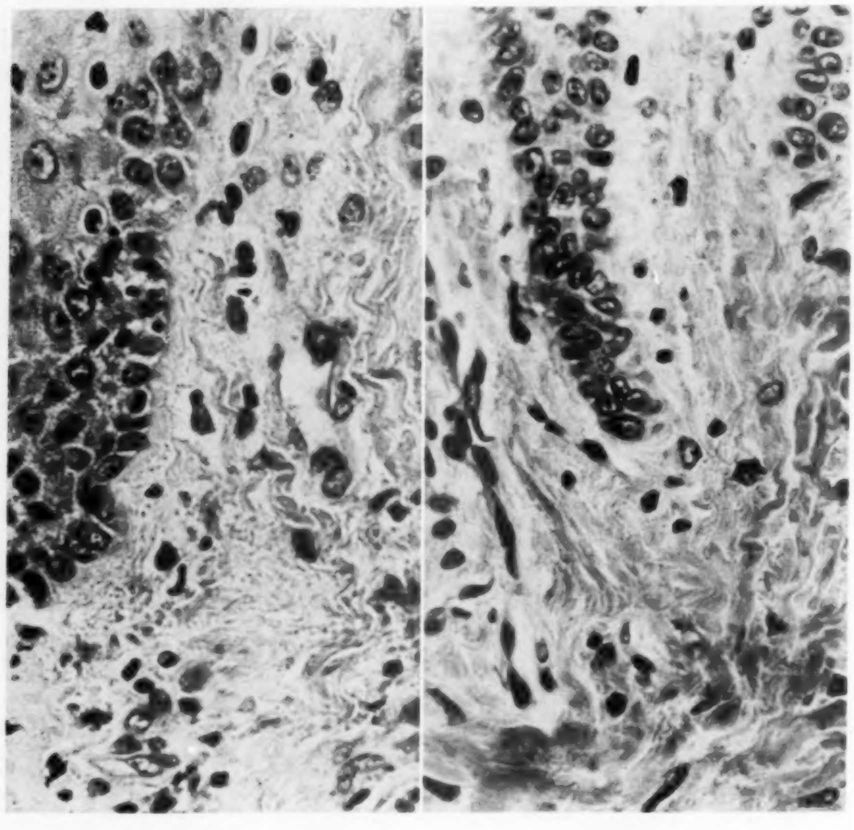

Fig. 6. Fig. 7.

Fig. 6.—Same case as in Fig. 1. Magnification ×750. Alveolar gingivae shows prominence of capillaries and young fibroblasts. There is also an increased amount of collagen. Compare with normal tissue (Fig. 7).

Fig. 7.—Same case as Fig. 2. Normal for comparison with Fig. 6. Magnification ×750.

Special Stains.—Testing with special stains, it was observed that the gums of the insulin-treated series contained more glycogen granules than normal tissue. Where inflammatory cells were present in the corium, the cytoplasm of all these cells contained glycogen which was particularly prominent in the plasma cells.[1] The distribution of the glycogen was as follows: A markedly increased number of granules were found in both the alveolar and areolar gingivae. They were scattered throughout the epithelium, being seen prominently even in the basal cell layer. A small number were seen in the corium.

This is a striking deviation from the microscopic findings in normal tissue where a relatively small amount of glycogen is seen in the areolar gingivae and even less in the alveolar gingivae, and where the glycogen-staining granules are concentrated chiefly in the upper half of the epithelium (Figs. 8, 9, 10, 11, 12, and 13).

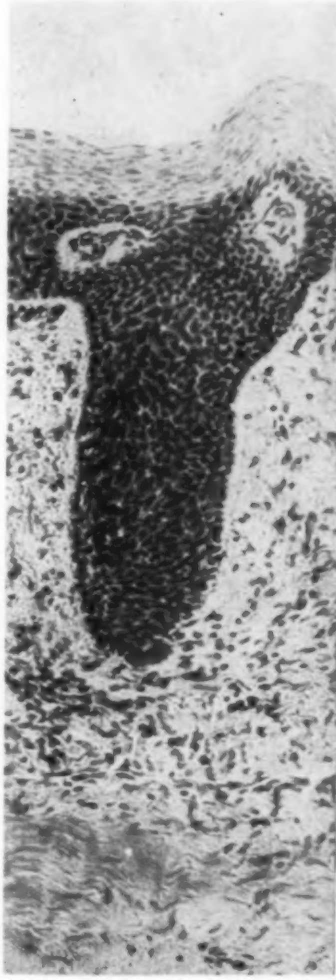

Fig. 8.

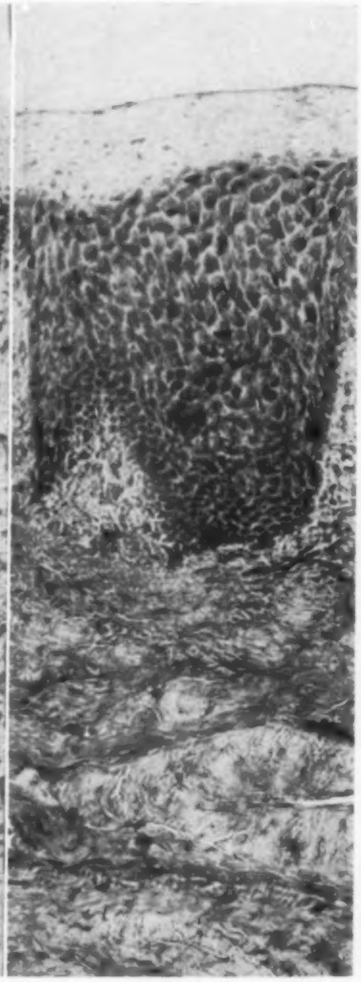

Fig. 9.

Fig. 8.—Male, white, aged 13 years. Duration of diabetes: two years. Insulin dosage: 20 units protamine plus 10 units regular. Food intake: 1,700 calories. Control good. Section upper left second incisor papilla, areolar gingiva. Magnification ×185. Best's carmine stain for glycogen. Shows marked increase in glycogen present in the gingival mucous membrane. The deep black spots are the glycogen granules in the cytoplasm. Note that glycogen is deposited here as deep as the basal layer. Compare with Fig. 9.

Fig. 9.—Same case as Fig. 2. Magnification ×185. Best's carmine stain for glycogen in normal gums. Areolar gingivae. Note the deep black spots in the cytoplasm. The glycogen normally is confined to the upper half of the gingivae and is more marked in the mucous membrane portion. In fact, very little is seen in the alveolar gingiva normally. In this tissue, the deposits are small when compared with Fig. 8.

The mucicarmine stain disclosed the following: In normal tissue, a small amount of deep red-staining mucinous material was seen in the corium, chiefly below the basal cell layer and around the blood vessels. In the insulin-treated tissue, there was less mucinous material and this was confined largely to the area around the blood vessels.

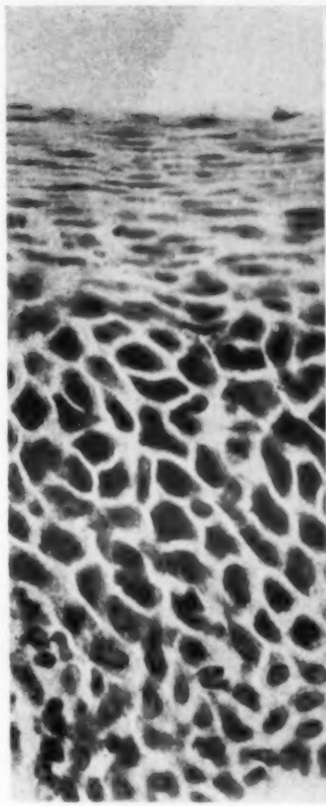

Fig. 10.

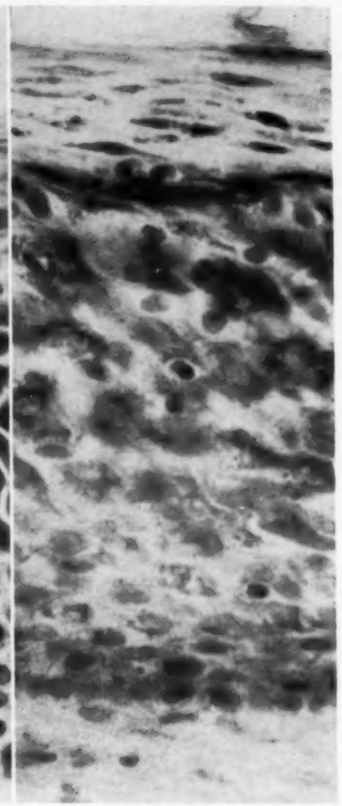

Fig. 11.

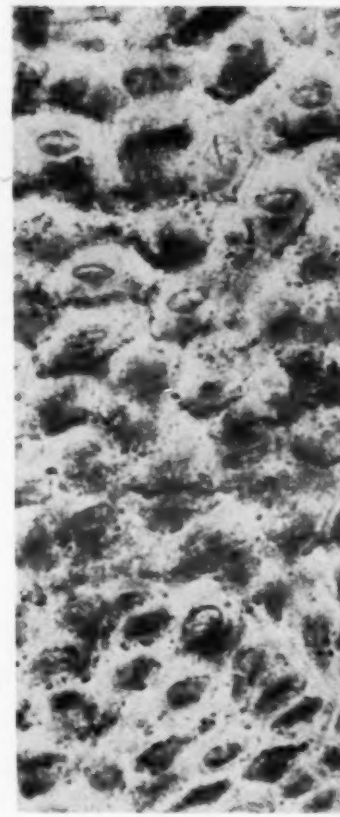

Fig. 12.

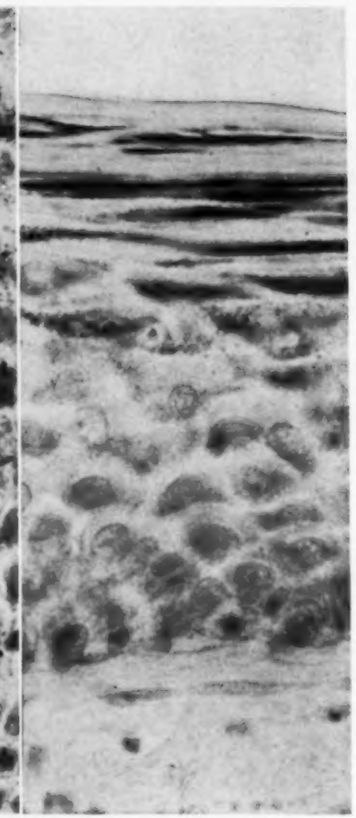

Fig. 13.

Fig. 10.—High power of Fig. 8. Magnification ×900.

Fig. 11.—High power of Fig. 9. Magnification ×900.

Fig. 12.—Female, white, aged 63 years. Edentulous. Biopsy upper right cuspid area. Duration of diabetes: over eleven years. Insulin dosage: between 30 and 40 units protamine insulin. Food intake: 1,520 calories. Control poor. Areolar gingivae. Magnification ×1100. Best's carmine stain for glycogen shows distribution of granules throughout tissue. For comparison with Fig. 13 (diet control).

Fig. 13.—Female, white, aged 57 years. Biopsy upper left cuspid papilla. Areolar gingiva. Magnification ×900. Diabetic condition discovered four months previous to biopsy. Given insulin for eleven days at onset. Restricted diet. Good control without insulin. Shows glycogen granules limited to upper half of tissue. The appearance here as to amount of glycogen is that of a normal gum tissue. Compare with Fig. 12.

Osmic acid stain showed both normal and insulin-treated gingivae negative for fat.

There was constancy of findings in the entire group. While generally the juvenile tissue appeared more healthy than that of the adults, the tissue in adults conformed to the group pattern even though there were more clinical gingival inflammations in the adults and of a more serious nature. For example, in one case, despite a subacute Vincent's infection of over a year's duration, there was surprisingly little inflammatory exudate in the corium.

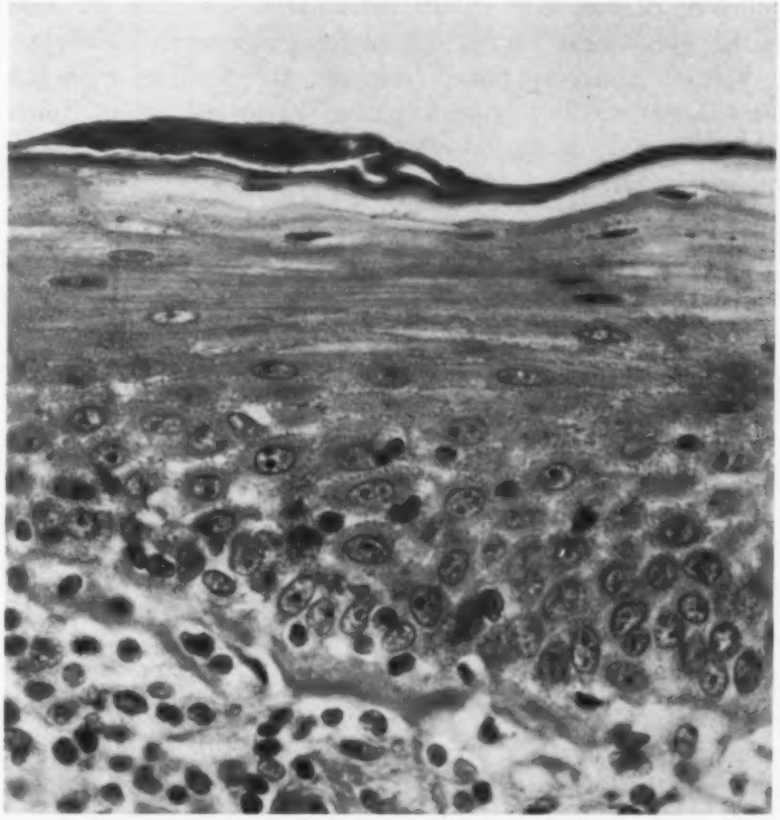

Fig. 14.—Same case as in Fig. 13. Mucous membrane. Magnification ×850. A thin layer of keratin is seen in the areolar gingiva, where none is seen normally. (Dietary control alone.)

FINDINGS IN GINGIVAE OF DIET-CONTROLLED CASES

The two cases of mild diabetes controlled by diet alone showed the following gingival changes: Grossly, the tissues appeared fairly normal. Microscopically, there was a slight edema throughout. The epithelium in the alveolar gingivae appeared normal. Changes were found in the papillary layer and in the areolar epithelium. In the papillary layer scattered throughout the entire section, perivascular foci of inflammatory cells were seen. Immediately under the basal cell layer of the epithelium, evidence of degenerative change was noted, in marked degree in some areas. The degeneration was characterized by edema and necrosis of the cells.

In the areolar epithelium in one case there was a flattening of the peg pattern so that the basal cells formed a straight line instead of giving the usual scalloped effect. Hyperkeratinization was evidenced by keratin on the areolar gingivae in both cases and epithelial pearls in the alveolar gingivae of one (Fig. 14).

Testing with special stains, the glycogen was comparable to normal in amount and distribution.

FINDINGS IN THE GINGIVAE OF FEMALE RHESUS MONKEYS

The purpose of this experiment was: (1) to note the effect of injected insulin on the blood sugar curves and on the gingivae and oral mucous membranes of normal monkeys, and to compare the findings with the gingival changes seen in the insulin-treated humans; (2) to test the reaction of topical applications of insulin on the blood sugar curves and on the gingivae both locally and systemically.

Four healthy female monkeys were selected as subjects (Nos. 686, 687, 688, and 689). They were fed a daily standardized diet consisting of carbohydrate 150 grams, protein 20 grams, fat 15 grams. The largest meal was at midday. Weights were recorded periodically.

The blood sugar curves were studied, two on each monkey preliminary to the use of insulin. There was no suspension or variation in the diet. In each instance the taking of blood specimens was started at or shortly after the midday meal and was continued at half-hourly intervals for five hours (eleven samples for each blood sugar curve). The blood was collected by venepuncture into sodium fluoride and the determinations were made in duplicate according to the Folin-Malmros method adapted to the photoelectric colorimeter by Saifer, Valenstein, and Hughes.[2] The curves shown in Fig. 15 represent the average of two curves for each animal. The same procedure was repeated after insulin treatment was instituted.

Two monkeys (Nos. 686 and 687) were given insulin injections. The initial dosage for each was 2 units (½ unit per kilogram of body weight). This amount was thought to be warranted owing to the high initial blood sugars and the high carbohydrate diet. Injections were made fifteen minutes before the midday meal. Only a slight drop in blood sugar was noted. The dosage was then increased arbitrarily to 2 units in the morning and 4 units in the afternoon (2-4-0). This regime was continued for forty days. A satisfactory drop in blood sugar was seen in both cases. (See Fig. 16*A* for average curves.) At irregular intervals afternoon specimens were taken to check continued insulin action. This was confirmed. On one occasion, Monkey 686, a poor feeder, suffered a hypoglycemic reaction three and one-half hours after an injection of 4 units of insulin. The blood sugar was 44 mg. per cent.

Comparing the curves with and without insulin, it was observed that two hours after the 4-unit injection of insulin there was a 55 mg. per cent drop in the blood sugar.

The two remaining monkeys (Nos. 688 and 689) received insulin topically. Pure crystalline insulin (1 mg. equivalent to 20 to 22 units) was dissolved in

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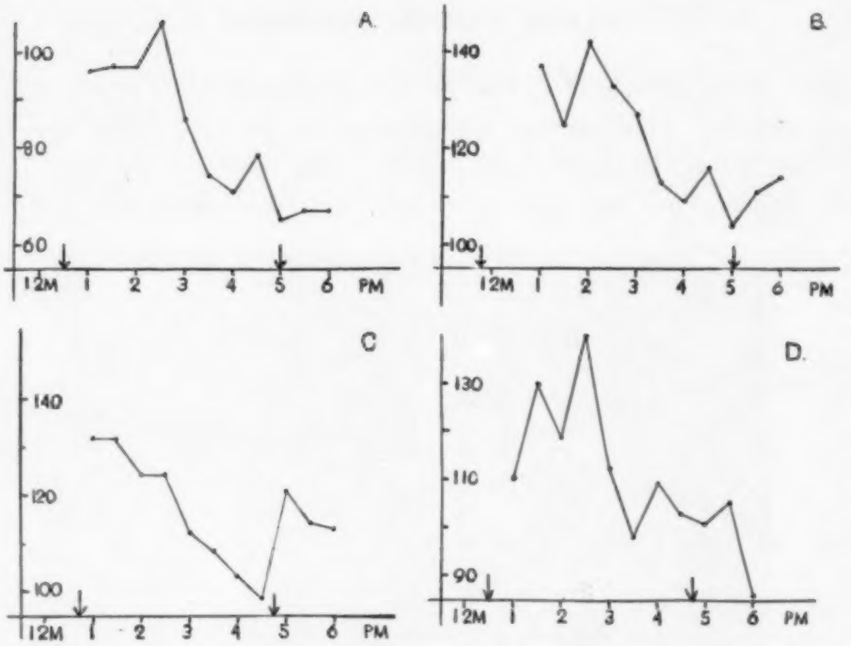

Fig. 15.—Average of two blood sugar curves before application of insulin every half hour for five hours.*

A, Monkey 686. Weight: 3,200 grams at beginning of experiment and 3,280 at end.
B, Monkey 687. Weight: 3,570 grams at beginning of experiment and 3,930 at end.
C, Monkey 688. Weight: 3,960 grams at beginning of experiment and 3,700 at end.
D, Monkey 689. Weight: 4,000 grams at beginning of experiment and 4,000 at end.

↓ = Feedings.

*Blood samples taken two days to a week apart and determinations were made in duplicate.

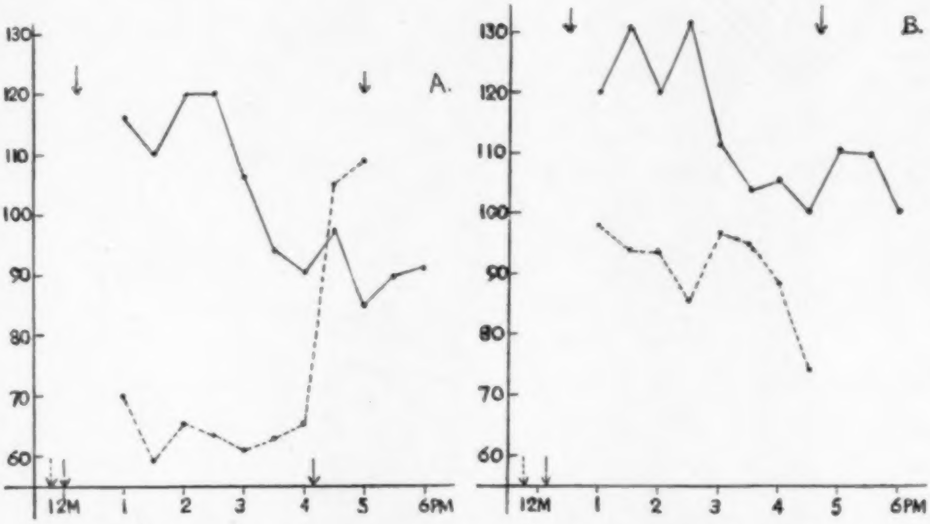

Fig. 16.—Average blood sugar curves of insulin-treated female monkeys.

A, Monkeys 686 and 687. Injected animals. Blood samples taken five days apart. Determinations were made in duplicate. Monkey 686 was not a good feeder, and on sixteenth and thirtieth days after injections began, animal suffered a hypoglycemic reaction three and one-half hours after injection of 4 units of insulin. Blood sugar was 44 mg. per cent. Monkey 687 menstruated for two days beginning on day of taking blood for second blood sugar curve near end of experiment.

B, Monkeys 688 and 689. Insulin applied topically. Blood samples taken two weeks apart. Monkey 688 menstruated twice during course of experiment. First two-day period unrelated to taking of blood sugar curve. Second period started on day of taking blood for second blood sugar curve near end of experiment.

All animals were in good condition at autopsy.

↓ = Feedings.

⇣ = Injection of 4 units crystalline insulin or topical application of 200 units crystalline insulin.

________ Before insulin.

\- - - - - - - - After insulin.

ethyl alcohol (70 per cent)* so that 0.5 c.c. of solution was equal to 200 to 220 units of insulin. This amount was painted on the left upper gum with a camel's hair brush (33 applications in a forty-day period). As a control, ethyl alcohol (70 per cent) was painted on the right upper gum at the same time.

Fig. 17.

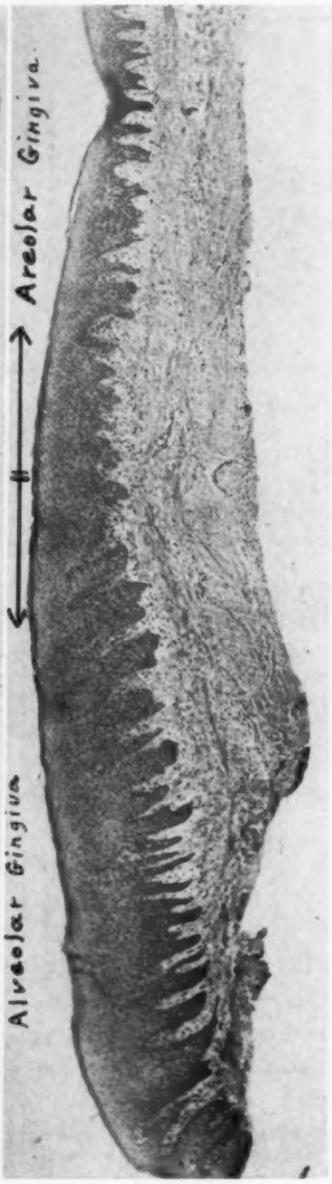

Fig. 18.

Fig. 17.—Monkey 689. Pre-experimental biopsy, upper left cuspid papilla. Magnification ×50.

Fig. 18.—Monkey 689. Lower right cuspid papilla. Section taken at end of experiment. Magnification ×50. This area was not treated topically and shows the systemic effect of the topically applied insulin. There is slight hyperplasia of both connective tissue and epithelium and a layer of keratin is seen on mucous membrane.

The average blood sugar curves are shown in Fig 16*B*. Comparing the two curves, it was seen that two hours after the application of the insulin a drop of 31 mg. per cent occurred. In order to verify the legitimacy of this drop, treatment was suspended for a period of three days during the course of the ex-

*While 70 per cent alcohol is known to be a tissue irritant, its quality of rapid evaporation offered a technical advantage in rendering the insulin absorption more effective since it prevented the loss incurred when using slow drying solutions.

periment. Another blood sugar curve was studied. This showed a return to the preinsulin level.

Calculating from the drop obtained with 4 units injected, it may be reasonable to conclude that 2.3 units were effectively absorbed after topical application; that is a ratio of 1.1 units per 100 units applied. Major[8] reported on an insulin nasal spray by means of which it was calculated that 1 unit in 100 was absorbed.

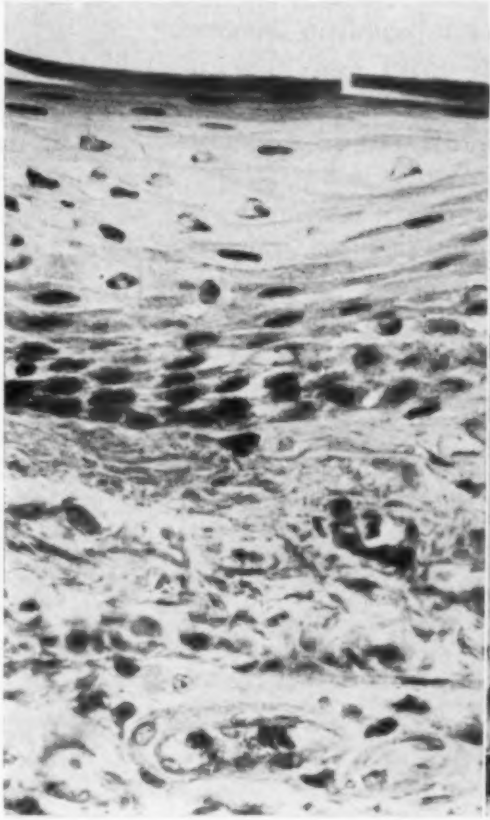

Fig. 19.

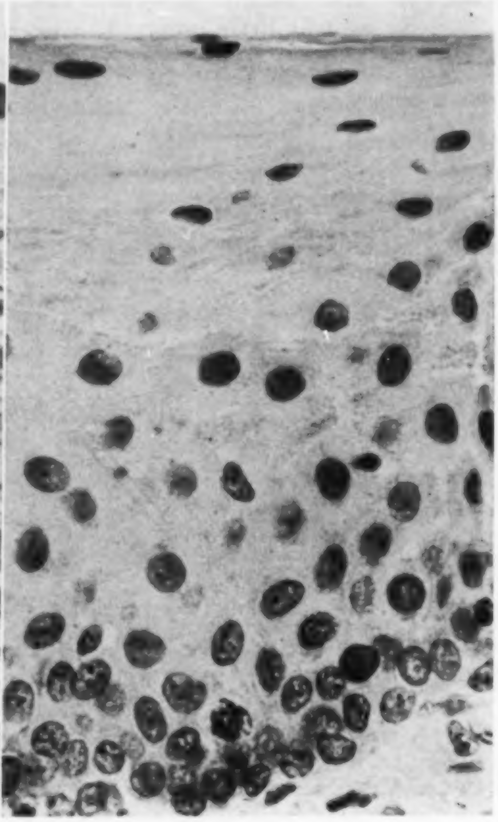

Fig. 20.

Fig. 19.—High power of Fig. 18. Magnification ×850. Shows keratin on surface of mucous membrane.

Fig. 20.—Same monkey as in Fig. 19. Upper left cuspid papilla. High power of Fig. 17. Magnification ×850. Preexperimental. Shows normal mucous membrane without keratin layer. For comparison with Fig. 19.

The curves show further that the insulin, injected and topically applied, prevented the occurrence of postcibal blood sugar elevations. This finding is reversed in the noninsulin curves.

The gingivae of the monkeys were studied in much the same way as those of the human group. The results were as follows:

Insulin Injections.—Grossly, there were few changes noted in gum color or consistency. Microscopically, the changes resembled those seen in the humans with the following differences:

1. Hyperplasia of both epithelium and connective tissue and hyperkeratinization were not as marked.

2. Formation of keratin on the areolar surface and oral mucous membranes was slight.

3. The prickle cells were not as large and not as uniform in size.

4. There was little flattening of the peg pattern.

5. The thickness of the corium was increased, but the connective tissue was not as dense as in the human group.

6. There was not much change in the inflammatory exudate.

7. There was little increase in glycogen deposit in the gums.*

Topical Application.—Grossly, during the first days, the gingivae appeared tender, with surface desquamation. This effect was noted in both the experimental and control areas and was attributed to irritation caused by the alcohol. After about a week the desquamation healed without discontinuance of treatment. Subsequently, the tissue appeared thicker and showed a violaceous color of almost the same intensity on both sides.

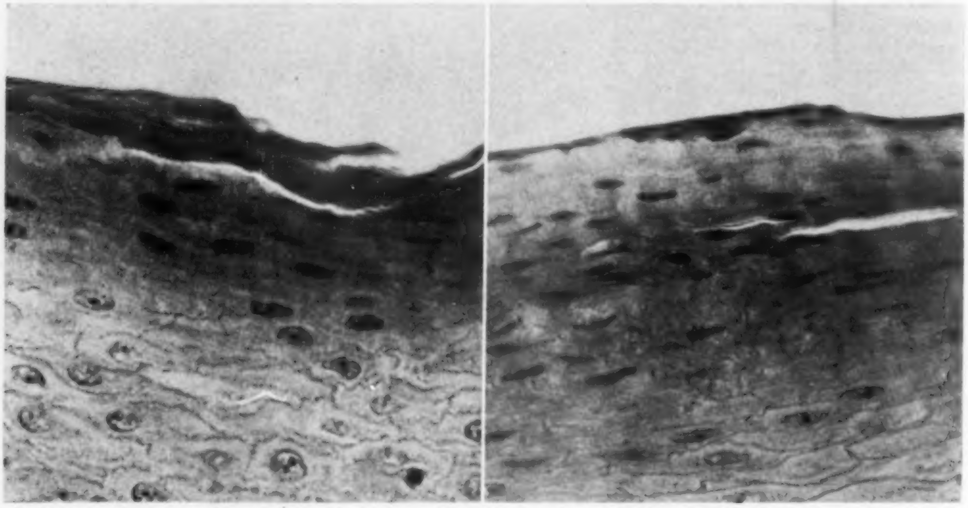

Fig. 21. Fig. 22.

Fig. 21.—Monkey 689, female. Magnification ×850. Upper left cuspid papilla—experimental side. Biopsy taken at end of experiment. Insulin dissolved in 70 per cent alcohol, applied topically. Mucous membrane. Shows changes due to both the insulin and alcohol. However, there is a better keratin layer here and less parakeratosis when compared with control tissue in Fig. 22.

Fig. 22.—Monkey 689. Upper right cuspid papilla. Magnification ×850. Control side. Biopsy taken at end of experiment. Seventy per cent alcohol applied topically. Mucous membrane. Shows changes due to irritation effect of alcohol. There is a deeper layer of parakeratosis as compared with Fig. 21, but only a thin layer of keratin was formed.

Microscopically, the surfaces of both areas disclosed an atypical hyperkeratinization about two or three cells deep. The tissues took a more intense hematoxylin stain. These changes were attributed largely to the alcohol. The degree of change was more marked on the experimental side, however, indicating a possible slight insulin effect. The experimental area showed some hyperplasia of the epithelium and connective tissue which was not seen on the control side (Figs. 17, 18, 19, 20, 21, 22, and 23).

*Monkeys normally do not have glycogen in the gums in quantities comparable to that seen in human beings.

Glycogen was seen prominently on the experimental side. It was more marked here than in the injected animals. On the control side, there was little glycogen observable (Fig. 24).

Sections of gingivae were examined from the lower jaws (untreated) of these animals. This tissue showed slight changes of the type seen in the injected animals. None of the changes described above, occurring as a possible result of the alcohol applications, were found. The changes noted were not present in the pre-experimental biopsies (Figs. 18 and 19).

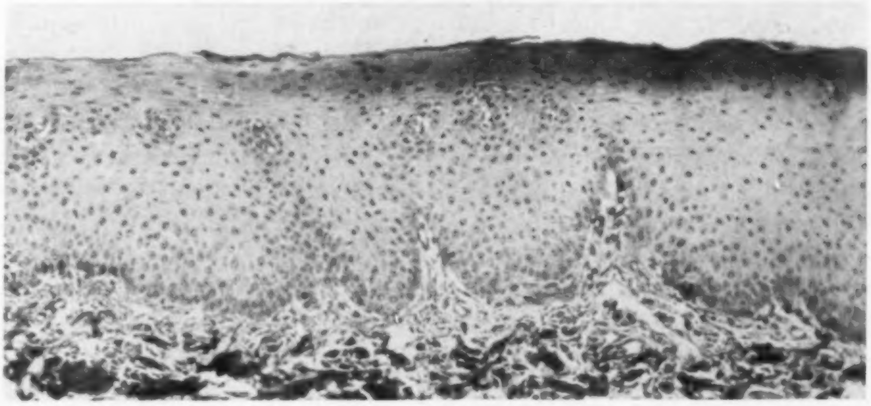

Fig. 23.—Same tissue as in Fig. 21. Magnification ×185. Shows mucous membrane at junction of topically insulin-treated and untreated areas. The changes were confined to the treated areas.

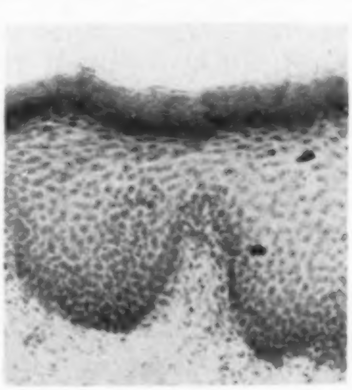

Fig. 24.—Monkey 688. Upper left cuspid papilla. Magnification ×185. Mucous membrane of monkey treated with insulin applied topically. Shows glycogen granules in cytoplasm in upper third of tissue. Normally, practically no glycogen is seen in monkey gums with the Best's carmine stain. Here, there were definite deposits in sufficient quantity to make this an important finding. Compare with Figs. 8 and 9.

DISCUSSION

The most prominent changes in the gums and oral mucous membranes of the insulin-treated diabetic human subjects were: hyperplasia of both epithelium and connective tissue, giving to the gums the thickened appearance seen clinically; hyperkeratinization; increased glycogen deposition as evidenced by Best's carmine stain; increased fibroblasts and prominent capillaries; reduced inflammatory exudate in the corium. We have pointed out in previous reports that hyperkeratinization offers a protection against local irritation and infection.

The insulin-injected normal monkeys showed changes in the direction of those cited above but comparatively slight in degree.

The insulin applied topically to the gums of normal monkeys appeared to have a mild systemic effect, but the most noteworthy change was the increased amount of glycogen, not apparent in the injected animals.

The biopsies of the gums of the two middle-aged women, whose diabetes was controlled by diet alone, disclosed hyperkeratinization in the areolar gingivae, a factor which must be taken into consideration when an attempt is made to evaluate the various gingival changes reported here.

These changes, most numerous and prominent in the insulin treated human beings, occur also under other conditions where diabetes does not enter as a factor. For example, keratin is seen normally in the alveolar gingivae of human beings and monkeys but rarely in the mucous membranes. Hyperkeratinization as evidenced by increased thickness of the keratin layer on the alveolar gingivae or the formation of a new layer on the mucous membranes may be found in vitamin A deficiency, after injections of large doses of estrogenic[4] and androgenic[5] substances over a long period of time, in hypothyroidism,[6, 7] and in some forms of vitamin B deficiency.[8] The clinical manifestations of vitamin B deficiency are discussed in *Part I* of this report and elsewhere.[9, 10] High carotene and low vitamin A values in the plasma are also prevalent in hypothyroidism.[11] Hyperplasia of both epithelium and connective tissue is seen in vitamin A deficiency and after injections of estrogenic and androgenic substances.[12]

The presence of nutritional deficiencies in the juvenile subjects, of which those in this report constituted part of the larger group, was established in a study by one of us (W. C. L.).[13] The blood plasma levels of carotene, vitamin A, vitamin C, and cholesterol were determined and compared with a control group of normals. High carotene was found in about 25 per cent, low vitamin A in 68 per cent of that group. The remaining 32 per cent in the latter category gave values consistently placing them among the low normals. In 4 per cent the ascorbic acid content was low. In 26 per cent, the cholesterol was high (over 230 mg. per cent). Since the most common finding was low plasma vitamin A, the assumption that a low vitamin A may be a factor in bringing about the gingival changes is tenable. The hyperplasia and hyperkeratinization in the mucous membranes may be a reparative metaplasia of the type described by Bessey and Wolbach[14] and attributed by them to vitamin A deficiency. These authors describe the changes as ". . . atrophy of the epithelium concerned, reparative proliferation of basal cells, and differentiation of the new product into a stratified keratinizing epithelium. This replacement epithelium, regardless of the previous function and structure in the region, is identical in all locations and comparable in all its layers with epidermis."

The underlying factors in producing the gingival changes in the diabetics may be the nutritional and metabolic imbalances which the insulin treatment or diet only partially corrects.

It should be noted that some hyperkeratinization was observed in the insulin-injected normal monkeys. This finding, interpreted in the light of the foregoing, might suggest that the systemic effect of insulin on the normal mon-

keys is to disturb slightly the metabolic status, and thus affect the gingival epithelium. This hypothesis is supported by Von Haam and Cappel,[15] who tested the effect of hormones upon cells grown in vitro. The use of 0.001 units of insulin per cubic centimeter of culture of fibroblasts isolated from mouse embryo heart produced a 1,000 per cent increase in the original explant in seven days. Ralli and Sherry[16] found a sharp decline in plasma and urinary vitamin C with the administration of insulin in normal and diabetic dogs. Intravenous injections of glucose prevented this reaction.

These data suggest that the changes observed may be of two-fold etiology: (1) the insulin treatment; (2) the nutritional and metabolic status of diabetics. The two diabetic women not receiving insulin emphasizes the latter hypothesis.

The increase in the prominence of the capillary bed and the reduction of inflammatory exudate may be a manifestation of insulin action and may be influential in combating gingival infection. The increased capillarity may also be responsible for the increased depositions of glycogen.

Hyperkeratinization in diabetics in areas other than the gums has been known, as evidenced by the literature. Keratosis pilaris, accompanied by low vitamin A in plasma, was found in about 9 per cent of the juveniles studied for nutritional deficiencies, previously referred to.

The finding of increased glycogen in the gums of insulin-treated human cases and in the topically insulin-treated monkeys is of especial interest although its function is obscure. It is significant that the topical applications produced an increase in the amount of glycogen deposited in the gums of normal monkeys which the parenteral method failed to do. This seems to indicate an intensified local action by the topical application method.

SUMMARY AND CONCLUSIONS

Histological studies were made of the gingivae of fourteen juvenile and five adult diabetes, all insulin-treated, and of two diet-controlled diabetics.

The insulin-treated cases showed hyperkeratinization, hyperplasia of epithelium and of connective tissue, increased glycogen deposition, increase of fibroblasts and prominence of the capillary bed, and reduction of inflammatory exudate in the corium. These changes constituted variations from the normal.

The diet-controlled cases showed hyperkeratinization in contrast to the normal and in comparison with the insulin-treated cases. There was evidence of degenerative and inflammatory changes which may be attributed to the patients' nutritional and metabolic status.

Four normal rhesus monkeys were studied for the systemic and local gingival effects of insulin. Insulin was injected parenterally to two monkeys and applied topically to the gingivae of two others.

Insulin-injected monkeys showed changes similar to those seen in insulin-treated diabetics, but in much lesser degree. There were no increased glycogen deposits.

The topically treated animals showed the same slight changes as the in-injected monkeys. This was attributed to the systemic effect of the absorbed insulin. Additional hyperkeratinization was seen in that region of the gums where the insulin was applied, and was attributed to the local application. The

hyperkeratinization in these areas was greater in amount than in those considered to be of systemic origin. The areas of application also disclosed a noteworthy increase in the glycogen content of the gingivae. These changes emphasize the benefits of the topical application when such results are desired.

The occurrence of hyperkeratinization and hyperplasia in conditions other than diabetes is discussed. The high incidence of suboptimal vitamin A plasma level in diabetics is presented as a possible factor in the production of the changes seen in the gingivae.

It is suggested that insulin itself as well as the diabetes may be an agent creating a metabolic disturbance in the cells of the gingivae.

The deposition of an increased amount of glycogen in the gingivae in the insulin-treated diabetics and in the monkeys receiving insulin topically is of especial interest but of unknown import.

The changes shown in the gingivae and oral mucous membranes of insulin-treated subjects, their violaceous coloration, thickening, hyperkeratinization, decrease in inflammatory exudate and increase in glycogen deposition may be of a protective nature.

Part I of this report appears in the *Journal of Dental Research*, October, 1944.

Our thanks are extended to Dr. Earl T. Engle, Columbia University, for suggestions.

We wish to express our thanks to the Lilly Research Laboratories and to Dr. F. B. Peck for the supply of crystalline insulin used in these experiments.

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BLOOD DYSCRASIAS IN RELATION TO SECONDARY AND PRIMARY HEMORRHAGES, POSTOPERATIVE

Hunter Leo Harang, D.D.S., New Orleans, La.

The importance of blood dyscrasias in relation to the oral condition and secondary hemorrhage should not be overlooked. This series of studies, which covers over 1,327 patients seen in our clinics over a period of thirty days, reveals the percentage of blood disorders that may exist. This percentage was secured by a very careful physical and routine blood examination.

The number of patients receiving treatment were selected from the group that came to our emergency room. Some were admitted from the hospital ambulance in a state of shock, weakness, and pain. Because these patients were but a small number of the large original group, we were enabled to give them more careful attention, especially if any type of oral pathology or hemorrhage was present.

When admitted to the emergency room, the patients were first given a brief examination, and then a complete history was taken. In this history, the time bleeding began and the length of time it had persisted were very important. The history throws an important light upon the case for it is understood that without an accurate history the case is of no value. The hemorrhage cases were classified into groups according to the cause of each. These groups were determined after the case history of each patient was taken.

The following information was secured:

1. What the patients may have done to promote hemorrhages, such as, picking the socket, sucking the clot out, or eating hard foods.
2. What previous surgery the patient had had, if any, and the history of bleeding.
3. What the condition of the mouth was at the time of extraction, and whether any previous bleeding occurred around the tooth or in the mouth.
4. The color of the patient—as to anemia, jaundice, cachexia, and malnutrition.
5. Palpation of the cervical, axillary, and auricular nodes, and also the spleen.

While the patient was still sitting in the chair, the clotting time was taken by the capillary tube method. The bleeding time was taken also, and 10 c.c. of blood was placed in the chemistry bottle for further study.

The computing of the vitamin C level, platelets, prothrombin, calcium, and the total red count was done later. At this time a blood smear was made and dried as rapidly as possible. This was then placed aside for the careful study of the white cells. The white cell count was the most important part of the procedure, and it should be studied carefully, paying particular attention to the size, shape, color staining properties, and number of cells present.

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In studying the white cells, particular attention should be paid to the cellular origin, whether of myelogenous or of the more important lymphatic origin.

THE LEUCEMIAS

Table I gives the most interesting cases seen on our service. The first and the most important are those of lymphatic leucemia. The several cases that were diagnosed by us were classical and no debate was needed as to the diagnosis; they could be easily recognized as cases of leucemia, neutropenia, or agranulocytosis. It would have been an obvious and drastic mistake to have discharged these patients without a diagnosis of their blood dyscrasias.

TABLE I

PERCENTAGE DISTRIBUTION OF BLOOD DYSCRASIAS POSTOPERATIVE DETERMINED BY ROUTINE EXAMINATIONS

NUMBER OF PATIENTS SEEN IN CLINIC FOR ROUTINE EXTRACTIONS	NUMBER OF PATIENTS SEEN IN 30 DAYS	
	White	432
	Negro	895
	Total	1,327
	NUMBER OF PATIENTS OPERATED ON	
	White	423
	Negro	895
	Total	1,318
PATIENTS RETURNED TO EMERGENCY ROOM WITH PRIMARY OR SECONDARY HEMORRHAGES (%)	1. Pernicious anemia	5
	2. Lymphatic leucemia	3
	3. Thrombocytopenic purpura	2
	4. Vitamin C deficiency	1
	5. Microcytic hypochromic anemia	4
	6. Calcium level	1
	7. Pyorrhea	4
	8. Poor hygiene and treatment	5
	9. Syphilitic ulcer	1

Leucemia, and agranulocytosis or neutropenia are two fundamentally different diseases although the former would suggest merely a depression and the latter a stimulation of leucopoietic activity. Leucemia is a neoplastic disease of the leucopoietic tissues, and the removal of the causative agent after establishment of a neoplasm will no longer influence the course of the disease. On the other hand, agranulocytosis, or a milder form of it, neutropenia, can be produced by a variety of agents, and the process is reversible; that is, when the causative agent is removed, the complete restitution may occur. This is very important as the use of the sulfonamides may produce an agranulocytosis that may be confusing if a careful and accurate history is not taken.

There are many agents which depress the granulocyte-forming elements of the bone marrow. Most of these are chemicals, such as the sulfonamides, aminopyrine, arsphenamine, benzene, and related compounds, but x-ray agents must not be omitted. The cases in which the cause of agranulocytosis is not evident are spoken of as idiopathic, but there is no reason to believe that these forms of agranulocytosis differ any from those that are produced by known agents.

Case Report.—R. T., Negro male, 51 years of age, was admitted on May 27, 1943, and died Sept. 14, 1943.

Three weeks prior to admission the patient had an onset of nocturnal fever and chills. He had a continuous throbbing headache for two weeks, and nocturia five to six times a night. He had no signs of dysuria or hematuria or signs referable to the urinary system. Bowel movements had become sluggish until he had taken as much as three doses of Epsom salts a day. The appetite had been very poor and sodium bicarbonate had been used to relieve postcibal distention for the past three or four months. A slight trauma to the right leg in the past four years had caused a large ulcer to develop. He had had no paralysis or paresthesia, no history of hip or arm shots, penile ulcer, or bad blood.

About eight days before admission while the patient was working in the field, his nose started to bleed and continued to bleed for a day and a half. The local physician told him that his blood pressure was too high and that he should have several bad teeth removed. After the teeth had been removed the bleeding continued for five days. He was brought to the hospital and was seen in the emergency room. Here his blood pressure was found to be 60/45, and he received treatment for shock at once. After having received 800 c.c. of blood and 1,000 c.c. of 10 per cent glucose in normal saline, the patient's blood pressure rose only about 10 points, thus indicating that he had a cardiac regurgitation.

Upon examination, the patient's mouth revealed a large amount of spongy proliferated tissue in the lower anterior region of the mandible. After treatment of the slow oozing from this area, it was found that the hemorrhages were mostly from two small roots that were found hidden in spongy gingival tissue. The following day these were removed and the gums were sutured.

Laboratory findings will be found in Table II listed under the lymphatic leucemias.

Clinical Course.—Repeated blood transfusions were used after the diagnosis of leucemia was established. On Sept. 11, 1943, the patient developed severe pain in the right side of his chest and there were many moist râles heard at the base of the lungs. Cough became productive of a white sputum. Temperature rose to 104.1° F. On September 13 the patient was considerably worse, complaining of dyspnea. Nasal oxygen was administered, but he became very dyspneic and restless and complained of generalized pain all over his body. The temperature was "spiking" from the time of admission until the patient expired.

Discussion of Case.—This patient, having had a history of bleeding for the past two years, should have had a blood examination at once, because upon examination of the white blood cells it was very clear that the patient had leucemia. Besides, this patient's cervical lymph nodes were palpable and so was the spleen. An early diagnosis would have given the patient a better chance for recovery.

This case is typical of all leucemias that are picked up because of an early history of bleeding. Bleeding from sockets and nose deserves careful attention. Such patients should be referred to the medical staff for treatment, as was this patient after the diagnosis was established.

AGRANULOCYTOSIS

In agranulocytosis there is in addition to the danger of hemorrhage the danger of the absence of the normal protecting mechanism against infections from microorganisms that are normal inhabitants of the mucous membranes. Such bacteria may therefore invade the mucous membrane and produce a necrosing inflammation. Similar necrotizing inflammation with agranulocytosis, however, may occur in places other than the oral cavity and it is not uncommon in the gastrointestinal tract.

Oral hygiene is important in the treatment of agranulocytosis as well as in the leucemias, because patients suffering from these diseases are very susceptible to infections about the teeth and the mucous membranes. The most conservative means should be taken in carrying out any operative procedures. Frequently the patient may present chronic gingivitis with bleeding or a postoperative hemorrhage, and may seek the aid of the dentist long before consulting a physician. These patients have a tendency to bleed constantly and may become almost exsanguinated.

ANEMIA

The number of patients that presented with blood disorders is small. Among these, anemia gives the largest incidence. The anemias made up about 30 per cent of these cases, and therefore are of greater importance than the leucemias. The subject of anemia is too great to be presented here, but a summary of the different kinds found in routine clinical examinations will be given.

Macrocytic Anemia.—There is in the diet an extrinsic factor which is heat stable, and in the stomach juice there is a thermolabile factor, the intrinsic factor, and the two reacting together furnish the end product. This end material is absorbed and stored in the liver and then released through the circulation, finally bringing about the maturation of the marrow's red cells which enter into the circulation.

The macrocytic anemias can be conveniently classified as follows:

1. Macrocytic anemias due to a faulty diet. These are found in pellagra and tropical sprue, in which the diet is deficient particularly in proteins and other accessory food elements.

2. Cases in which both the diet and the gastric juice are adequate, but in which there is impaired absorption.

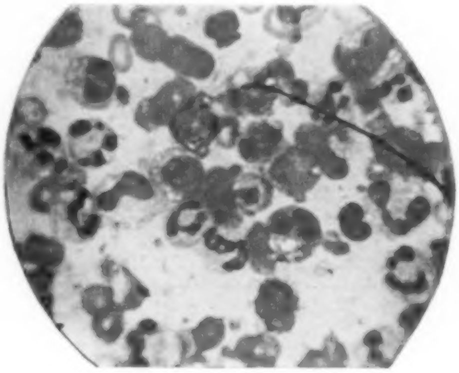
3. Cases of liver damage and cirrhosis in which anemia develops, probably due to lack of proper storage of the antianemic principle.

Differential diagnosis is not of importance in this discussion; nor will treatment be considered here. Diagnosis of macrocytic anemia, however, is of greatest interest to us. If a patient is brought to us for treatment of oral disease, anemia should be recognized, because it may be the direct and primary cause of the condition.

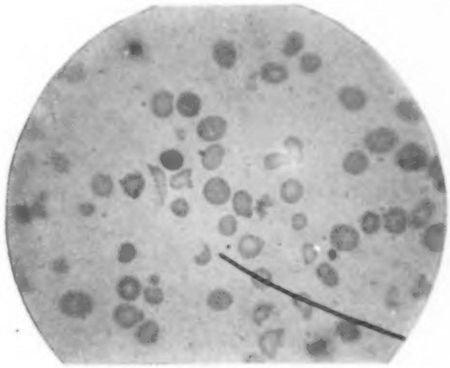
As is shown on the accompanying chart, a patient with anemia is given a complete hematologic examination. The results reveal that these patients show a normal clotting time, but that the bleeding time is prolonged. The red cells are large and irregularly shaped. We find a perfect picture of

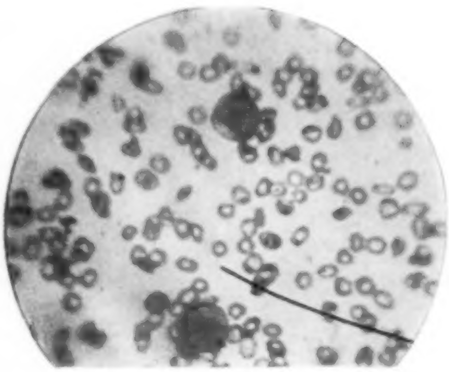
IMPORTANT BLOOD DYSCRASIAS

Myelogenous Leucemia (1)

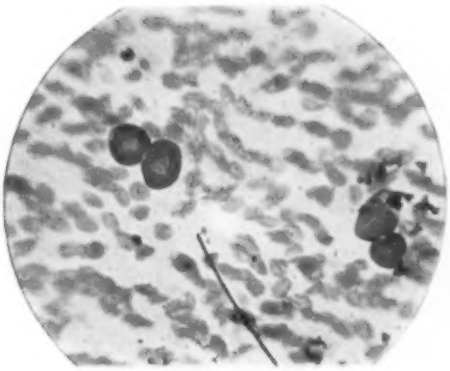


Pernicious Anemia (2)





Microcytic Hypochromic Anemia (3)



Lymphatic Leucemia (4)

1. Myelogenous leucemia showing numerous premyelocytes which have completely crowded out the red blood cells.
2. Pernicious anemia with marked absence of white cells and few red cells appearing in a normal field of the microscope. These cells display marked anisocytosis, poikilocytosis, hyperchromic macrocytes, racket cells, and microcytes.
3. Microcytic hypochromic anemia showing the typical "halo" cells, with few white cells present, and the achromia of all red cells.
4. Lymphatic leucemia with large typical lymphocytes, which are very numerous.

anisocytosis and poikilocytosis, with an almost normal or slightly lowered white count. The hemoglobin level is low and the bleeding time almost directly proportioned to it.

The one reason for bleeding in the cases of pernicious and macrocytic anemia is the failure of the new blood cells left to maintain enough prothrombin and hemoglobin to promote stoppage of hemorrhage. The anemias were all correctly diagnosed and pictures were taken to conform the relation of the laboratory reports to the actual conditions found. The photomicrographs show the size, shape, form, and staining characteristics of the cells which give a diagnosis of anemia.

Microcytic Hypochromic Anemia.—The microcytic hypochromic anemias are very easily diagnosed and are even easier to treat from the clinical standpoint. The reason for excessive hemorrhages in these cases is the lack of iron in the blood. This faulty synthesis of iron in the red blood cells denies the cell the full amount of hemoglobin that is necessary for normal function. In the large number of patients that were observed with secondary hemorrhage, the red cells were almost too devoid of hemoglobin to give the cells any color at all. The diagnosis is very easily arrived at after looking at the stained red cells and the end red count. These patients respond to treatment of iron in a few weeks and their coagulation time is normal.

THROMBOCYTOPENIC PURPURA

The third most important blood dyscrasia that can be easily diagnosed is purpura. The several cases that came to our emergency rooms for treatment were small children that had persistent bleeding from the gums for as long as two weeks. These patients usually present with very healthy-looking oral tissue; however, upon close observation it is found that the constant bleeding is not from the teeth but from the mucous membrane around the teeth; in fact, from all the mucous membrane present in the mouth. This is a slow oozing type of hemorrhage which no treatment or local application will stop. These cases had been diagnosed as pyorrhea, Vincent's angina, and thrush, before seen in our clinic.

Case Report.—C. B., 3-year-old white female, was seen in the accident room at 11:30 P.M. with a constant bleeding of the gums. By a clinical history and a close examination, purpura was immediately considered. This was later proved by a complete blood picture. This patient was admitted to the hospital and the platelets were found to be as low as 30,000, with many counting chambers almost devoid of any platelets. The tourniquet test, after ten minutes, showed many petechial hemorrhages in the arm, thus confirming the diagnosis. Bleeding and coagulation time were found to be very long as shown in Table II. Prothrombin and sedimentation rate was done. This also showed unusually prolonged bleeding time. These patients may bleed from the mouth, stomach, nose, and the peripheral hemorrhagic spots.

In the study of the purpuras it must not be overlooked that similar hemorrhages may occur from the same areas and yet of a different etiology. This was found in the case of a Negro male that came in after suffering from hemorrhage for seven days. This patient seemed to have a slow escape of blood

TABLE II

HEMATOLOGY

TYPE OF DYSCRASIA	HEMOGLOBIN (GM. %)	R B. C.	PLATELETS	W. B. C.	POLYMORPHOCYTES	EOSINOPHILES	BASOPHILES	MONOCYTES	LYMPHOCYTES	COAGULATION (MIN.)	BLEEDING (MIN.)	CALCIUM LEVEL	PROTHROMBIN TIME (MIN.)
Lymphatic leucemia	7.7	2,740,000	91,000	91,000	2	7	–	–	86	15	45	9	4
Lymphatic leucemia	9.2	4,860,000	90,000	238,000	0.5	2.5	0.5	–	95.9	18	32	8.5	3
Pernicious anemia	5.5	1,500,000	90,000	2,650	66	1.0	0.5	–	32.5	10	22	9.8	1
Pernicious anemia	3.7	1,000,000	63,000	2,350	70	–	–	2.5	26.5	8	25	9	1
Purpura	8.1	4,800,000	30,000	10,000	32	8	–	8	60	8	22	8.1	2.5
Microcytic anemia	6.0	3,090,000	259,000	8,550	37	1.5	2	1	58.5	16	30	8	2
Calcium level	8.8	4,200,000	230,000	9,600	42	6	4	5	40	14	26	3.8	2.5

into the mouth from around a large mass of hypertrophied tissue on the crest of the lower ridges. The blood smears showed no blood dyscrasias, and the white cells appeared normal in size and shape and also as to their cellular origin. The calcium level was normal and the platelets sufficient in number. Upon the return of the vitamin C level, however, it was found to be so low that vitamin C was given intravenously immediately; this was soon supplemented by 900 Gm. of cevitamic acid by mouth and a thigh calorific diet. This patient responded to the treatment and in twelve days was considered in fair condition and was discharged to home treatment.

ANALYSIS OF CASES STUDIED

By means of a routine checkup of patients presenting primary and secondary hemorrhages, blood disorders may be diagnosed early. Table II gives blood chemistries and blood counts found in patients that were subjected to examination.

The above cases are a brief example of what may be discovered if a little time is devoted to a more careful examination of the patient. Contrary to the usual teaching that most bleeders are found to have a low calcium level, my series of examinations revealed only one such case in a large number of other blood disorders. By the study of the blood it is proved that a cause for all bleeding is found very easily, and that the calcium level is not the deficient part of the clotting mechanism as has been thought. The importance of prolonged bleeding should not be overlooked, and a careful study of the blood should be made, and a definite cause found. These patients deserve careful handling so that a blood dyscrasia does not go undiagnosed for a long period of time.

THE PARALYSIS OF THE FACIAL NERVE AFTER MANDIBULAR ANESTHETIC INJECTION

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OCCASIONALLY, a few minutes after a mandibular anesthetic injection, a brusque facial paralysis occurs which is especially noticeable when the patient, spontaneously or upon request, makes any facial gesture. The impossibility of shutting the eyelid of the injected side is plainly visible. When trying to close the eye, the ocular globe turns up, and the iris disappears under the upper eyelid (Bell's sign). The lips show distortion, which becomes grotesque when the patient is asked to whistle or laugh. The natural wrinkles of the forehead, nose, and cheeks disappear. We have also observed an abundant lacrimal secretion.

All these signs indicate the facial paralysis which in neurology is called "peripheral type" (it reaches both branches of the facial nerve).

This condition remains unaltered for approximately one hour; then the paralysis begins to decline till it disappears totally within half an hour or an hour. Some authors give it a longer duration, even a whole day.

This postanesthetic accident does not carry with it serious consequences; nevertheless, it has an alarming effect on the patient, because in most cases he is aware of his condition. Though the operator reassures him, explaining it as a dangerless and temporary accident, the relationship between the patient and the doctor is disturbed. The patient generally believes that there was a faulty technique.

Several explanations have been given to account for the causes of the ways in which this accident occurs.

Several authors have speculated on the subject, but none of them have experimented with facts.

CRITICAL STUDY OF THE HYPOTHESES

1. *By the Anastomoses Existing Between the Trigeminal and the Facial Nerves.*—Guido Fischer says: "Facial paralysis may also occur following infraorbital, mandibular, and mental anesthesia, because the facial and trigeminal nerve trunks maintain numerous communications, particularly in the infraorbital plexus, in the pterygoid fossa, and in the vicinity of the third trigeminal branch.

"Owing to the relationship of the lingual nerve with the chorda tympani and the facial nerve, the latter may be affected in case of intense lingual anesthesia that reaches as far as the chorda tympani."

Obviously, this explanation is absolutely insufficient. It is hard to conceive that the anesthetic action should be sent from one nerve to another through a nervous bridge. But we may accept the possibility that a reflex stimulus could use the tympanum cord to produce a reflex phenomenon. Such

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phenomenon might be sketched as follows: excitation of the trigeminal nerve, conduction of the stimulus to the facial nerve, and reaction of this nerve in a paralysis. However, we think that this interpretation lacks a neurophysiological foundation.

The same is true of the other numerous anastomoses between the facial and the trigeminal nerves.

2. *By a Sympathetic-Trigeminal-Facial Reflex.*—Bercher, Chompret, Houpert, Kritchewski, Neveu Derotrie, Rahausen, and Rodier believe that a sympathetic-trigeminal-facial reflex is responsible for these motor phenomena. This reflex would produce the reflex vasodilatation of the vasa nervorum which would originate a temporary compression of the facial trunk in its passage through the aqueduct of Fallopius. The subsequent result is paralysis.

The starting point of this rèflex mechanism may be the sympathetic plexus which surrounds the external carotid. In case of a too profound puncture, the point of the needle and the liquid injected will naturally come too near the sympathetic plexus, producing an excitation.

No doubt this hypothesis is very suggestive. However, it raises a question, which is important enough to defeat it.

Physiologically it is inconceivable that the autocompression of the nerve within the aqueduct of Fallopius through vasodilatation should be of such an intensity as to produce in a short time its functional inhibition, and that the paralysis produced could revert so rapidly. Physiology teaches us that a long and intense compression is required to paralyze a motor nerve; and once the paralysis has been attained, it takes the nerve a long time to recover its activity.

Both facts are absent in the accident studied, for we have seen paralysis start abruptly and disappear within one or two hours.

During our experiments we noticed that cutaneous hypernemias, which we consider the objective signs of vasodilatation by a sympathetic mechanism, and paralysis did not necessarily appear at the same time. Another fundamental objection is that the accident was produced after anesthesias which contained adrenalin, corbasil, or other vasoconstrictors. The presence of any of these elements prevents vasodilatation.

When a therapeutic vasodilatation by sympathetic mechanism is required, a solution of novocain without adrenalin is injected (Leriche).

3. *By Direct Action of the Anesthetic on the Facial Nerve.*—Dechaume, Durante Avellanal, and Neumann, believe that by a too deep puncture the liquid would enter the parotid, would spread through the glandular tissue and would impregnate the facial nerve trunk, which is enclosed in that gland.

Sicher and Lebedinsky attribute this paralysis to a similar mechanism but without considering the parotid tissue as the impregnating medium. They only claim that by injecting too high, the liquid would pervade the cellular perifacial tissue, and through it, the nerve trunk itself.

The anatomical and physiological conditions of the region injected make this etiology possible. We note this fact for it is the principal starting point of the experiments.

Observing Fig. 1 we can appreciate the proximity between the needle and the various organs in a too profound injection in the pterygomandibular space.

4. *By Direct Trigeminal-Facial Reflex.*—This hypothesis is sustained by Colombet, Kritchewski, Romey, and Chandy. According to them, "the irritation of the trigeminal would also cause a reflex irritation of the facial nerve. They see a certain parallelism between this phenomenon and the tic douloureux in the neuralgias of the trigeminal."

I present this theory briefly because of the scarcity of details in the bibliography which I consulted. This hypothesis concisely submitted by its supporters, is both disputable and acceptable; yet it is the one most adapted to a neurophysiological discussion.

It has been duly considered in this study, though in an indirect manner.

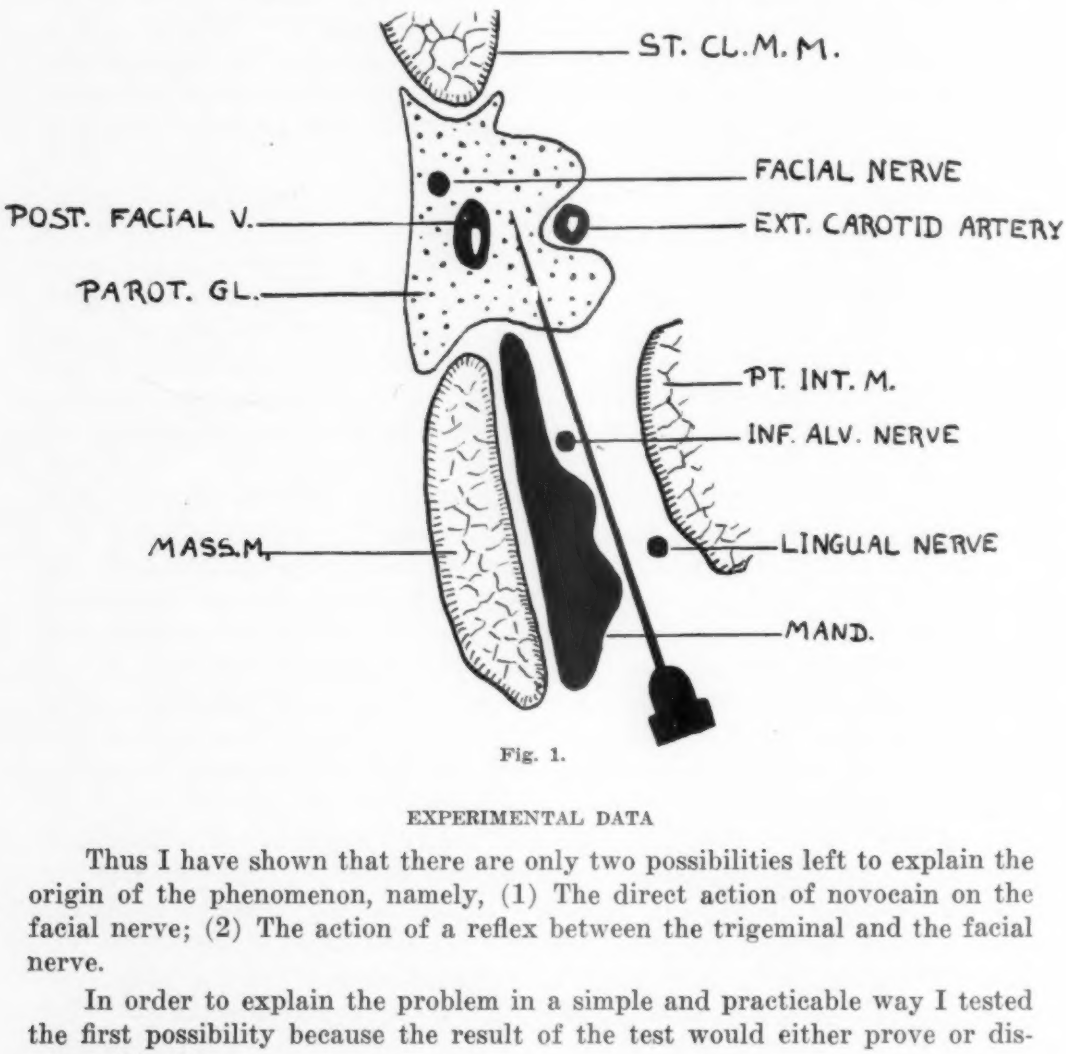

Fig. 1.

EXPERIMENTAL DATA

Thus I have shown that there are only two possibilities left to explain the origin of the phenomenon, namely, (1) The direct action of novocain on the facial nerve; (2) The action of a reflex between the trigeminal and the facial nerve.

In order to explain the problem in a simple and practicable way I tested the first possibility because the result of the test would either prove or disprove this theory.

I started a series of injections following the usual technique for mandibular anesthesia, but going 4 cm. deep with the needle.

This series consisted of 100 injections divided as follows: 50 (Cases 1 to 50) which we have called series A 1, in which we have used 4 c.c. of novocain (2 per cent) with adrenalin; and 50 (Cases 51 to 100) in which the same dose

of novocain without adrenalin (series A 2) was injected. The object of this subdivision was to prove the action which the vasoconstrictive drug could possibly have on facial paralysis.

The direction given to the injecting needle, according to the preceding indications, brought its point approximately to the facial nerve itself. In accordance with our measurements and anatomic comparisons, the liquid was definitely placed into the parotid gland. In this way all the requirements to produce the phenomenon according to hypothesis *3* were present.

The result of the 100 injections was as follows:

In 20, total paralyses resulted.

In 27, partial paralyses resulted (6 of the superior or temporal facial nerve and 21 of the lower or cervical facial nerve).

In 53 of these cases no akinetic phenomenon was produced.

Of the results noted, the following facts are significant:

1. There was no appreciable difference in the percentage of paralysis produced by injections of novocain with adrenalin and those of novocain alone.

As to the duration of the phenomenon the following differences were noted: with adrenalin, the average duration was 2 hours and 45 minutes; without adrenalin, the average duration was 18 minutes.

These results naturally have no great importance as we know that the solution without a vasoconstrictor is absorbed more rapidly. The fact that paralysis was produced after injections without adrenalin eliminates the vasoconstrictor as an etiological agent.

2. There is no doubt that the motor nerves are less receptive to anesthesia than the sensory ones.

3. Especially interesting was the fact that these paralyses appeared in two ways: some in a brusque form and others slowly, more or less in the same degree as the anesthetic effect appears and increases, when sensory fibers have been blocked. We found of total facial paralyses, 16 brusque and 4 slow; of partial facial paralyses, 27 (the total) slow.

By the fact that it is possible to locate the seat of the facial paralysis by observing certain functional changes, we observed the alteration of the gustatory sensation in the front two-thirds of the tongue which is controlled by the facial nerve through the tympanum cord. Such alteration would indicate whether the lesion was intrapetrous or extrapetrous. While the sensation disappeared or was attenuated, the direct action of the anesthetic on the nerve was eliminated since in no case would the anesthetic solution reach the facial nerve at the point where the tympanum cord branches off.

The test was done with saline solutions and eugenol. In general, the results were not very precise. Only in cases 59, 63, and 90 was noticed a definite reduction of the gustatory sensation.

The difficulty of applying the gustatory test is explained, because the determination is in itself difficult as it is based on subjective information. This fact is confirmed in the neurological treatises consulted. Moreover, the short duration of the phenomenon and the state of alarm and stupor of the individual under experiment prevent to a large extent a clear interpretation.

The phenomena of motor inhibition (observed in 47 per cent of the cases) as a result of novocain injections induced us to carry out another series of injections in order to study more closely the behavior of the facial nerve under this drug.

We then decided to reach it directly at its outgoing point at the stylomastoid foramen, using the following technique: The patient was placed in the accustomed position in the dental chair. We had him turn his head toward the opposite side from that selected for the injection, then we touched the mastoid apophysis, and in front and above its vertex (½ to 1 cm.) we inserted the needle to a depth which oscillated, according to the individual, from 1.5 to 1.8 cm. where the styloid apophysis is found, in front of which runs the facial trunk.

This series of experiments we have called B (Cases 101 to 150).

The results obtained were somewhat curious for it was only possible to produce total paralysis of the facial nerve in seventeen cases, or 34 per cent. Stranger still was the fact that eleven paralyses which affected only the upper branch, were produced though the common trunk had been injected at the outlet of the stylomastoid foramen.

We must make it clear that as these injections were only an experiment, we deliberately used a solution of novocain alone in order to relieve the patient of the consequent trouble of a long paralysis. The average duration of these paralyses was fifteen minutes, similar to the A 2 series.

A very important fact appears in the series B. All the paralyses came on more or less slowly. This fact confirms its etiology by novocain impregnation of the nerve. For this reason no gustatory alteration was observed in any of the cases.

From the results here obtained we can reaffirm the fact noted previously, that the motor nerves are less receptive to the anesthetic drugs.

CONCLUSIONS

The criticisms of the hypothesis, and the neurological and physiological studies of the phenomena observed during the development of our experimental injections lead us to formulate various conclusions with regard to the possible etiology of the facial paralysis which happens occasionally as a consequence of mandibular injection.

1. The existence of anastomosis between the trigeminal and the facial nerve and the hyperemic compression of the nerve by sympathetic action are discarded as causes.

2. For the following reasons it seems logical to eliminate also the possibility that the facial paralyses are produced by the direct effect of the anesthetic on the facial nerve:

a. The low percentage of paralysis reported when the trunk itself or its anatomic neighborhood had been deliberately injected.

b. The fact that the paralyses produced by way of experiment appeared under two definite aspects: most of them in a slow and progressive form, the others brusquely. *This leads us to believe that the paralyses which appear brusquely can be identified with those accidental ones studied.*

c. The appreciable amount of loss of taste in the front third of the tongue, found in the cases of brusque paralysis, indicates that its source is beyond the stylomastoid foramen, in the interior part of the petrous portion. It is inconceivable that the anesthetic solution can reach such distant points no matter how deeply the solution may have been injected into the pterygomandibular space.

d. The appearance of absolutely similar paralyses as a consequence of injections in zones far removed from the facial trunk, for example in the foramen ovale (four cases observed in our clinic).

e. If we consider that the liquid injected moving away from the mandibular nerve could be deposited into the parotid capsule, we do not believe in the coexistence of good mandibular anesthesia and intense paralysis.

In some observations of the accident, there was a perfect anesthesia. This fact has been proved several times in previous years in our clinic. Chompret also mentions it.

We might ask ourselves now after having eliminated the direct action of the anesthetic on the facial nerve: Why in the series A 1 and A 2 were there sixteen paralyses with all the characteristics of the accidental ones which we are studying? We firmly believe that these were caused by the other etiological factor: a reflex mechanism between the trigeminal and facial nerves.

In favor of this hypothesis we have the loss of taste in the front two-thirds of the tongue, although reported positively only in a few cases. This indicates its localization in the trajectory of the facial between the nucleus and the stylomastoid foramen. Another reason is that we have observed that the paralysis disappeared rapidly in some cases when giving the taste test with eugenol, a fact which is compatible, in our judgment, with a reflex cause. We must leave open the possibility that the sympathetic system may act as an intermediate link in this reflex mechanism, but in a very different manner from that attributed by hypothesis *3*.

We have already seen that the sympathetic perivascular plexus of the main blood vessels is always in the vicinity (the external carotid in the very profound mandibular injections, and the middle meningeal artery in the injections to the foramen ovale, after which we have also observed the same class of paralysis).

Based on the experiences previously explained and on our conferences with neurologists, we dare to formulate the following, final conclusion, at present hypothetical, regarding the etiology of facial paralysis after anesthesia:

It seems reasonable to suppose a phenomenon of inhibition of the facial nerve by a vascular motor reflex. The exact mechanism of this phenomenon is not known yet, but it can be essentially attributed to an alteration produced by *anemia or by a temporary vascular spasm,* in the trajectory of the facial nerve between the nucleus and the periphery. We cannot say definitely if the stimulating factor is of a toxic order (the anesthetic drug) or of a traumatic order (the needle).

The parallelism which exists in general between the duration of the anesthetic action and the paralysis inclines us to believe more in the action of the novocain as the inciting factor.

As a clinical precedent to consider the possibility of the production of a localized anemic zone, we have the anemic zones of the skin of the face, described by Kuhns as a postanesthetic complication, that would be caused by a vasomotor mechanism when the vascular walls are touched by the needle. These spasmodic states last about as long as the postanesthetic facial paralyses.

The rare occurrence of the accident we have studied may be attributed to a predisposition of the individual constitution for a vasomotor lability produced by certain agents.

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CASILLA 729

RADIOGRAPHIC FINDINGS OF FOREIGN BODY DEBRIS IN EDENTULOUS AREAS

JAMES L. BRADLEY, D.D.S., M.S.D.,* AND JAMES T. ASHWELL, D.D.S.,†
BETHESDA, MD.

A THOROUGH review of available dental literature discloses little evidence as to the statistical occurrence of metallic foreign bodies in edentulous areas.

Mead,[1] in a study of 713 cases, found 3.8 per cent of metal present in bone and soft tissues. Whereas Cook,[2] in a roentgenograhic examination of five hundred edentulous and partially edentulous mouths, found foreign material, including root canal fillings, broaches, needles, and amalgams, in 7 per cent of the cases. Schlack and Booth[3] found 5.949 per cent pathoses in an examination of one thousand and seventy-five roentgenograms of edentulous areas, but no attempt was made to classify these.

Foreign bodies in the edentulous jaw areas may be traced to some of the following causes: (1) introduction into the soft and hard tissues of fragments of fillings or of teeth broken during the extraction; (2) doing amalgam restorative work and extractions at the same sitting, under local anesthesia; (3) extracting other teeth before the sockets have completely healed.

PURPOSE

The purpose of our study was to determine the frequency of occurrence of metal in edentulous areas as shown in the radiographs on file at the Naval Dental School. No clinical observation was made, due to frequent transfer of personnel.

PROCEDURE

Three thousand, one hundred and seventeen edentulous areas from 1,218 cases were studied. An edentulous area was so considered wherever one or more teeth were missing in a continuous span and only included healed areas.

RESULTS

1. Of the 1,218 cases, 2.89 per cent showed apparent foreign body debris.
2. Three and eleven hundredths per cent of the edentulous areas disclosed metal.

CONCLUSION

These figures probably represent a fair cross-section average of the country as a whole; with the incidence at this level, certainly greater care needs to be exercised to prevent such accidents.

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From the Naval Dental School, National Naval Medical Center.

The opinions or assertions contained therein are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large (Art. 113 [2] U. S. Navy Regulations).

*Lieutenant Commander (DC) USN.
†Lieutenant (DC) USN.

Case Reports

CASE NO. 91

NEUROFIBROMA AFFECTING JAWS

MARTIN A. RUSHTON, M.A., M.B., L.D.S.

THE patient was a young man 18 years of age. Asymmetry of the face had been noticed at birth and became very marked at the age of 4 years; it had increased since, but not recently. Fig. 1 shows the appearance of the face. It was noted that the tumor extended from the right temple to the right submaxillary region, and was a diffuse mass in which firm nodules could be felt and

Fig. 1.

moved about. Movements of most of the facial muscles were present, but in the course of several plastic operations performed by Sir Harold Gillies, it was seen that the muscles had been almost completely replaced by tumor tissue in many parts. Sections of this tissue were repeatedly identified as plexiform neurofibroma.

From the E. M. S. Plastic and Jaw Unit, Basingstoke, England.

The state of the jaws is interesting and must be interpreted as partly due to distortion and absorption from pressure of the growth and partly to further interference with bone apposition at the normal sites.

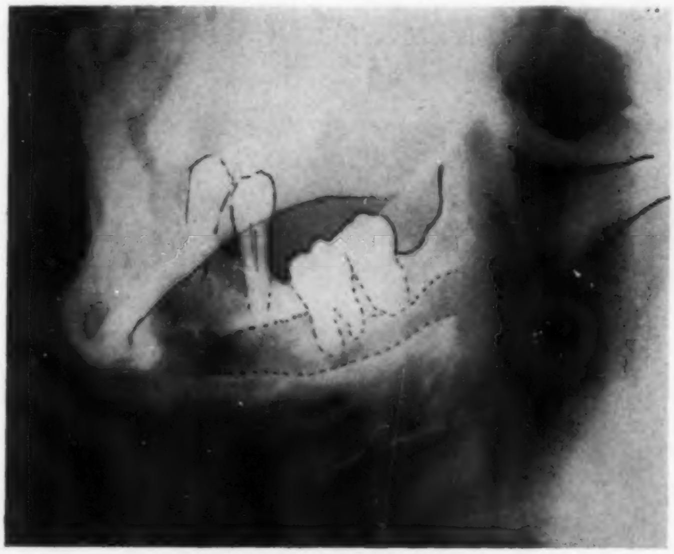


Fig. 2.—Right side. Greatly enlarged mandibular canal. Incomplete eruption of molars. Poor development of angle, etc.

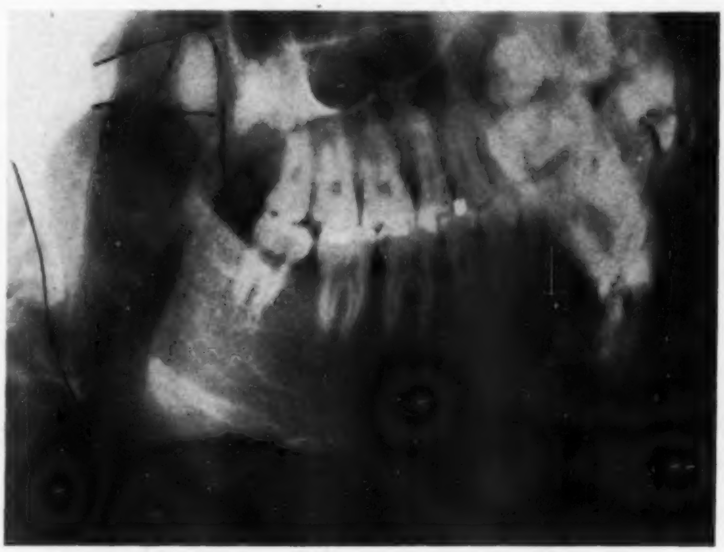


Fig. 3.—Normal left side for comparison.

The Upper Jaw.—On the right side the hollow of the palate is filled up and the anterior teeth are spaced, the central incisor having been carried to the left of the midline where there is also an unerupted supernumerary tooth. The alveolar process is protuberant and the anterior wall of the maxillary antrum was found to be very incomplete. The right second and third molars had been unable to erupt. The left side is approximately normal.

The Mandible.—The left side is powerfully constructed and of normal development, but the right is very abnormal (Figs. 2 and 3). The mandibular canal on the right is enormously enlarged, as in the case of neurofibroma af-

fecting the mandible recently described by Goldman (1944)* and is presumably infiltrated by the tumor. The latter appears also to have surroundered the roots of the right second and third molars which, as in the upper jaw, have failed to erupt. Comparison of the two sides of the jaw suggests that bone apposition has been partly prevented at all parts of the surface (except the condyle) and particularly at the posterior aspect of the ramus, lower border, and

Fig. 4.—Skull and mandibular defects; enlarged mental foramen.

posterior part of the alveolar process. The angular apposition is represented by a small and ragged prominence which is too far forward. The anterior teeth are spaced and half buried in the thickened soft tissue of the gum, and the molars are completely covered by a boss of soft material (Fig. 4). There is no lack of prominence of the bony chin on the affected side and the length of the bone from chin to condyle appears the same as on the other side. This is presumably the result of undisturbed condylar growth. The shortness of the lower border must be ascribed to defective angular and postangular bone apposition, probably due to infiltration of the periosteum. Treatment was by partial excision and tissue reduction.

*Goldman, H. M.: Case Reports From the Files of the Registry of Dental and Oral Pathology, AM. J. ORTHODONTICS AND ORAL SURG. (ORAL SURG. SECTION) 30: 289, 1944.

Editorial

The Oral Surgeon Looks at Malocclusion

As Editor of the *Oral Surgery Section* of the JOURNAL, the recent "Extraction Panel" in the *Orthodontic Section* has interested me considerably. I have seen good results from the extraction of four first premolars as well as from four first permanent molars, but I am sure this procedure is advisable only after great deliberation, and at the right time. Delebarre's statement quoted in one of the papers of the panel should serve as a guiding principle to the oral surgeon as well. This quotation of wisdom pronounced over a century ago, in 1815, deserves repetition and should be forever before our eyes:

"It is much easier to extract teeth than to determine whether it is absolutely necessary. The extraction of a tooth requires nothing more, on the part of the practitioner, than a degree of facility in the use of instruments that are usually employed in this operation; whilst the knowledge necessary to appreciate the consequences can only be acquired by time and study."

While the extraction of first premolars or molars is primarily of interest to the orthodontist from the point of view of immediate cosmetic or functional results, there is another problem which seems equally important, though more for the future welfare of the patient. It is a matter that some orthodontists do not consider properly because its effect is not seen until later, after the patient has been permanently discharged from his care. During the college years the patient often neglects dental care in the belief that the fine work of the orthodontist has been completed, and that there is nothing more to worry about. At this time a relapse frequently occurs, and is often associated with a problem more familiar to the oral surgeon than to the orthodontist, resulting from the erupting effort of the developing third molars that are impeded because of an underdevelopment of the jaw, which is probably the fundamental reason why the child needed orthodontic treatment in the first place.

I saw a statement in one of the panel papers to the effect that "the axis of the orthodontic sphere is made up basically of teeth . . . with multiplicity of teeth, with forms of teeth, with position of teeth, and with occlusion of teeth." As a pathologist, may I be permitted to state here that in my opinion the basis of the orthodontist's work should be founded on the development of the bones containing the teeth. To me the fundamental cause of malocclusion is either a disproportion of the upper jaw which is developed from the base of the skull, and the lower jaw which is an individual articulated bone, or disrelation of the size of the jaws to the size of the teeth.

The answer to the problem is, of course, the rendering of treatment at an early stage of the development of the bones that will produce an acceleration

of bone growth and thus a larger jaw, which will in turn provide adequate space for all the teeth, including the third molars. If this treatment is unsuccessful or not desirable, the second choice is to decrease the number of the teeth to meet the estimated adult size of the jaws. The first problem is solely one for

Fig. 1*A*.—Girl, 17 years of age, with postorthodontic disalignment of incisors.

Fig. 1*B*.—X-ray shows the developing third molar impeded against the second molar.

the orthodontist; the second is shared by the orthodontist and the oral surgeon, and consultations between the two should bring forth the best result. It is a pity that the members of the two specialties who have so much in common do not confer more frequently for the benefit of their mutual patients.

The fact mentioned in one of the papers that the removal of the first premolars to straighten anterior teeth when in labioversion causes the molars to move forward, should be looked at as an aid in the development and positioning of the third molars. The family dentist also should take part in such consultations. It has been the practice of a few dentists to extract the four first perma-

Fig. 2.—Pressure produced by the third molar causes tilting distally of the second molar.

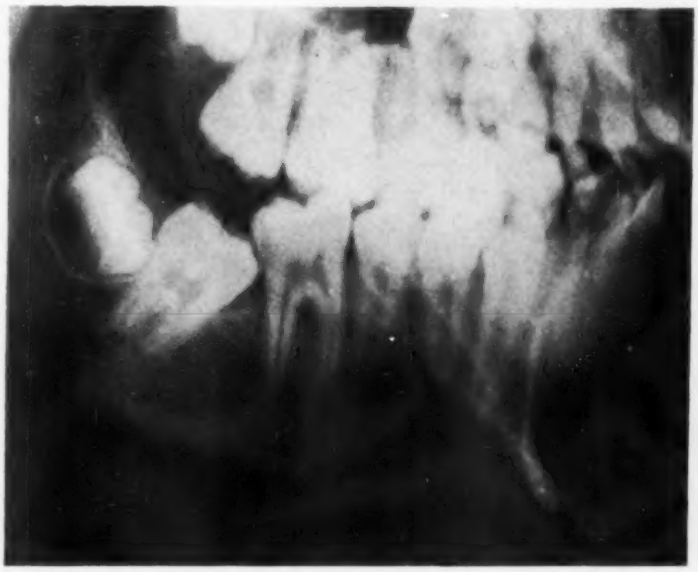


Fig. 3.—Second molar displaced by the third molar in a patient aged 12 years.

nent molars, especially if decayed, not only to correct orthodontic anomalies more easily, but also to remove teeth affected by disease in order to facilitate the normal eruption of healthy third molars. I have seen patients who have had this type of treatment. In some, the result was excellent; in others, it was only fair, because of tipping of the molars, or because the third molars were

underdeveloped, had short roots and a poor attachment. Unfortunately, at the time when the best results may be obtained from the extraction of the first molars, the development of the third molars has not advanced to a stage in which the size, root formation, and positioning can be accurately judged.

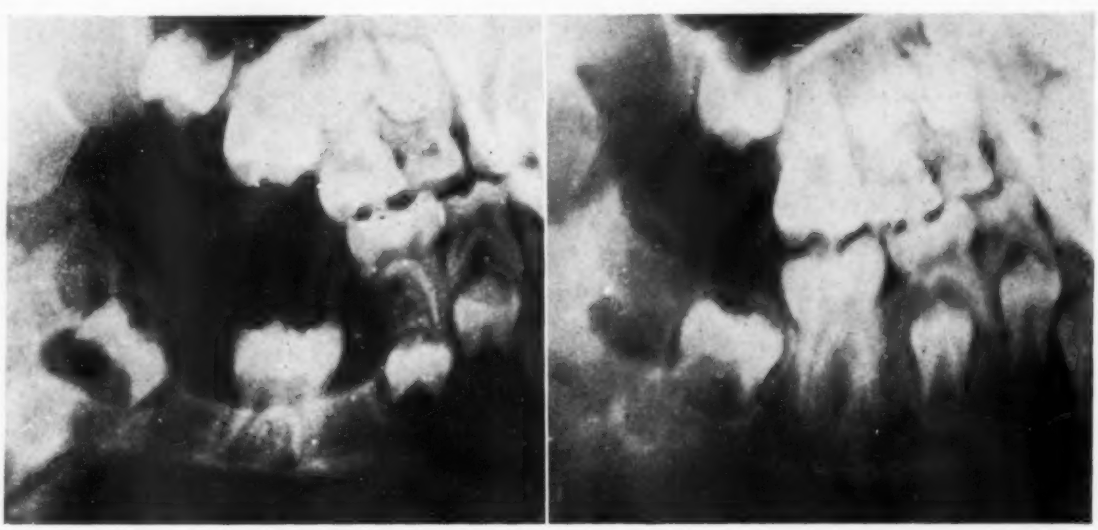
Fig. 4.—Mesiodens causing diastema between central incisors.

Figs. 5A and 5B.—Eruption of right central incisors is prevented by mesiodens.

Therefore, the oral surgeon, as a rule, hesitates to advise the removal of the first molar unless diseased, and favors the removal of the third molar. Another important subject concerns the correct time when the third molars should be removed. I feel that odontectomy before the root formation is two-thirds completed makes the operation unnecessarily difficult. On the other hand, waiting too long may give rise to postorthodontic disturbances usually seen by the general practitioner rather than the orthodontist who treated the primary malocclusion.

What are these postorthodontic occlusal disturbances? Here are the most common ones, with illustrations for some of which I am indebted to Dr. Fred R. Blumenthal, with whom I have been conferring in some of these cases: (1) Disalignment of the dental arch, first noticed in the incisor region (Figs. 1*A* and 1*B*). (2) Backward tilting of the second molars (Fig. 2) due to pressure exerted on their roots by the third molars. (3) Prevention of the eruption of the second molar (Fig. 3). This, of course, occurs much earlier, generally at a time when the patient is still in the hands of the orthodontist, but is frequently overlooked because no x-rays are taken.

Fig. 6.—Eruption cyst causing retention of maxillary canine in a boy 14 years of age.



A. *B*.

Fig. 7.—*A*, Dentigerous cyst preventing first molar from erupting, in a boy aged 7 years. *B*, After excision of the cyst, normal conditions were spontaneously re-established two years later.

Other sins of omission committed during the course of orthodontic treatment are the prolonged retention of deciduous teeth, the roots of which, for one reason or another, fail to resorb properly, and the overlooking of the develop-

ment of supernumerary teeth such as mesiodens, peridens, etc., which may produce a diastema betwen the incisors (Fig. 4) or other irregularities (Fig. 5). They are not always recognized at the primary x-ray examination, but may be found later when they are larger in size. Also, there is the failure to recognize retention cysts developing in the dental follicle surrounding the crown of the unerupted tooth. Such cysts generally produce only small bone defects because they form just under the surface of the alveolar bone. They are, however, very effective in preventing eruption of the involved tooth, because of the backward pressure exerted on the crown. Maxillary canines which fail to erupt are often obstructed by eruption cysts. A typical example is shown in Fig. 6. The removal of the cyst sac from the tooth will frequently allow the tooth to erupt spontaneously. I say frequently because the condition must be recognized and operated on at the time when the eruptive force of the tooth is still effective. To illustrate the force exerted by a cyst, I shall add an x-ray (Fig. 7*A*) used previously in one of my publications which shows a large cyst preventing the eruption of the first molar in a child aged 7 years. The removal of the cyst sac, and with it the elimination of pressure on the occlusal surface of the tooth and on the adjacent teeth, allowed the physiologic force that governs the positioning of the teeth to restore normal conditions without further aid (Fig. 7*B*).

The oral surgeon and orthodontist have much in common; this is why the combination of orthodontic and oral surgical papers published in one journal, the American Journal of Orthodontics and Oral Surgery, is of great value to both professions.

K. H. T.

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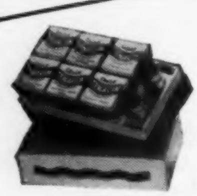


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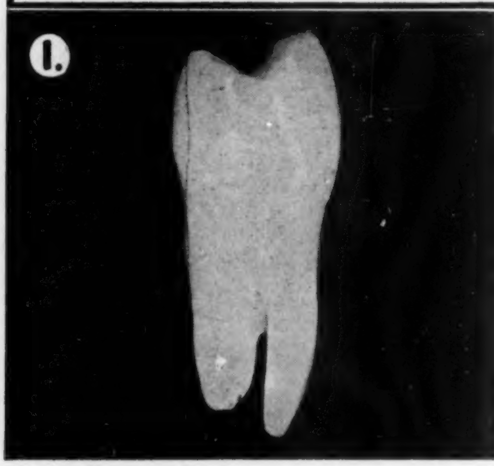

1. BEFORE BRUSHING. *This is an actual, unretouched photo. Notice absence of any abrasion. Compare to same tooth at right.*

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**Journal of Dental Research 20, Pages 583-595, Dec. '41.*

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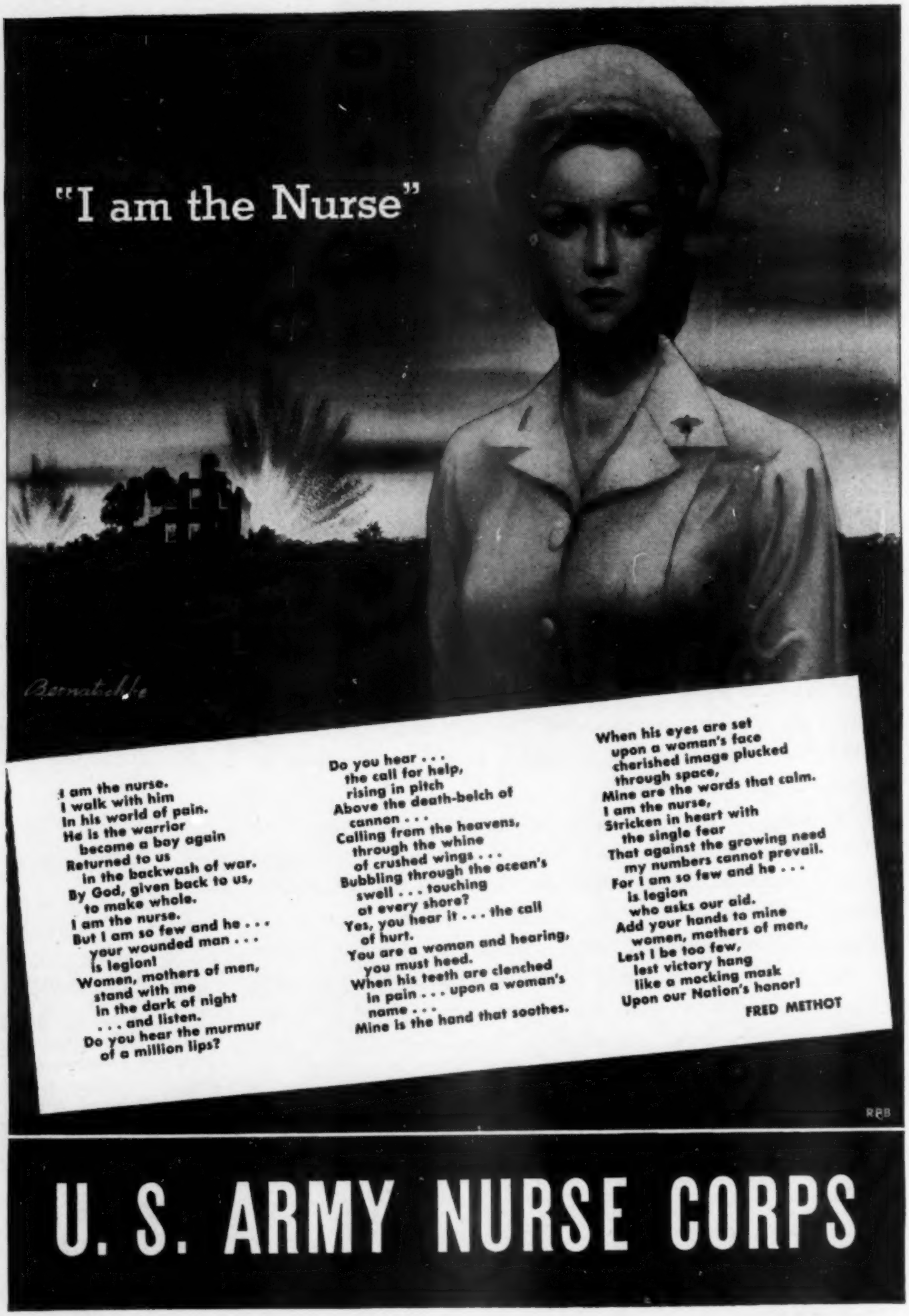
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Bernatschke
I am the nurse.
I walk with him
In his world of pain.
He is the warrior
become a boy again
Returned to us
in the backwash of war.
By God, given back to us,
to make whole.
I am the nurse.
But I am so few and he . . .
your wounded man . . .
is legion!
Women, mothers of men,
stand with me
in the dark of night
. . . and listen.
Do you hear the murmur
of a million lips?
Do you hear . . .
the call for help,
rising in pitch
Above the death-belch of
cannon . . .
Calling from the heavens,
through the whine
of crushed wings . . .
Bubbling through the ocean's
swell . . . touching
at every shore?
Yes, you hear it . . . the call
of hurt.
You are a woman and hearing,
you must heed.
When his teeth are clenched
in pain . . . upon a woman's
name . . .
Mine is the hand that soothes.
When his eyes are set
upon a woman's face
cherished image plucked
through space,
Mine are the words that calm.
I am the nurse,
Stricken in heart with
the single fear
That against the growing need
my numbers cannot prevail.
For I am so few and he . . .
is legion
who asks our aid.
Add your hands to mine
women, mothers of men,
Lest I be too few,
lest victory hang
like a mocking mask
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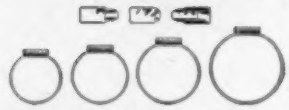

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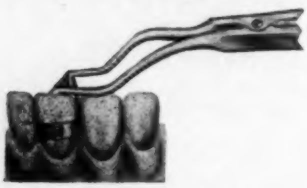

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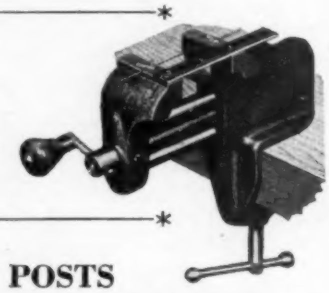

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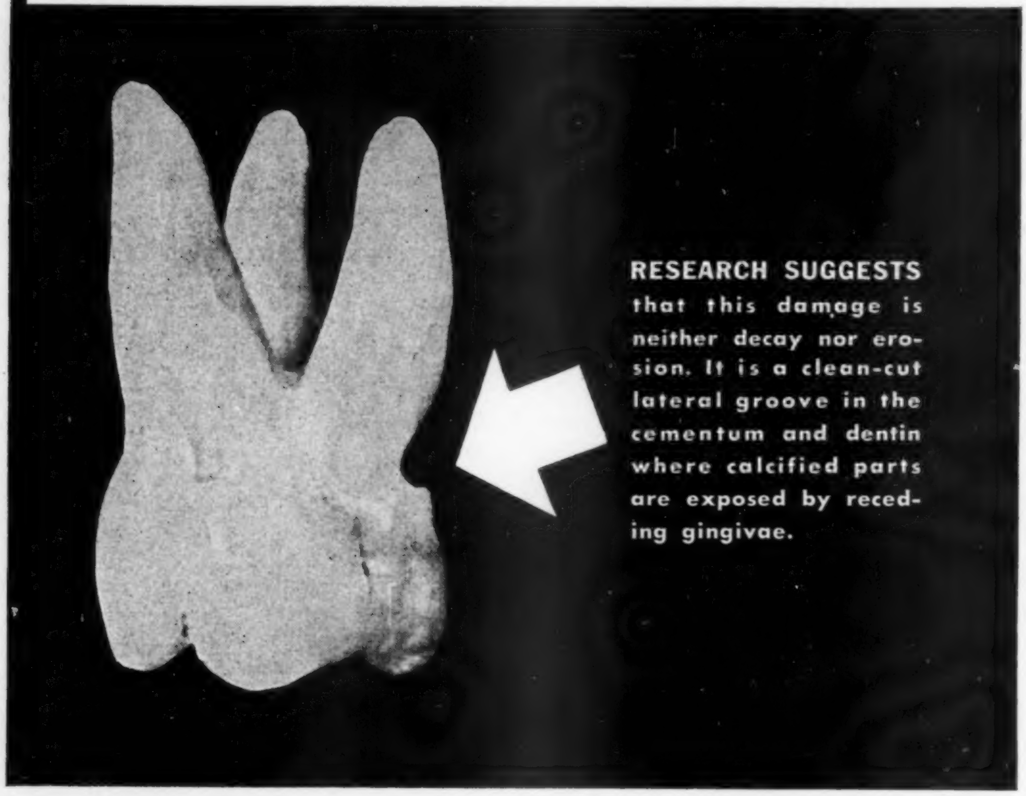
** Journal of Dental Research 20, 565-595, Dec. '41.*

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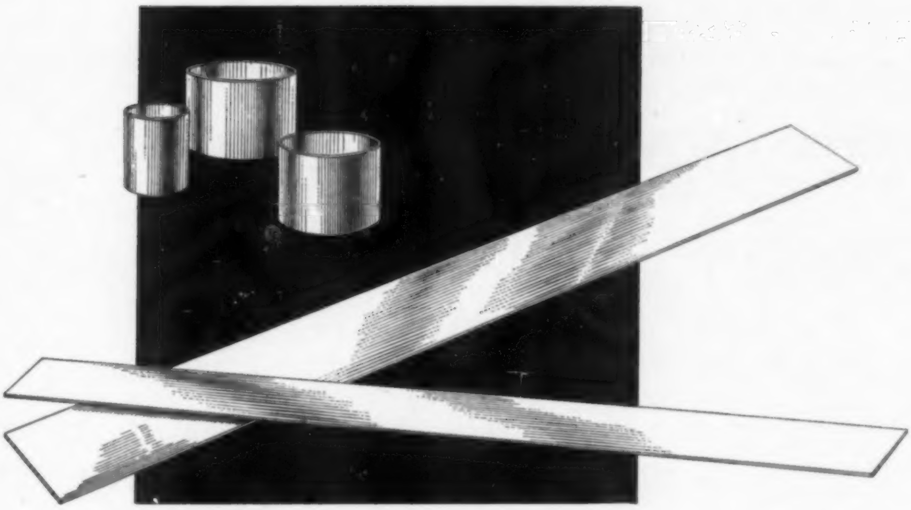

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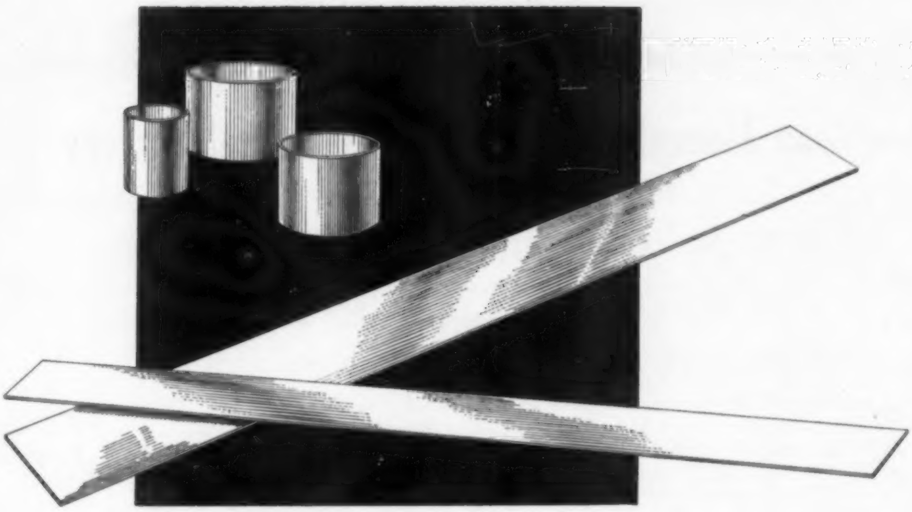

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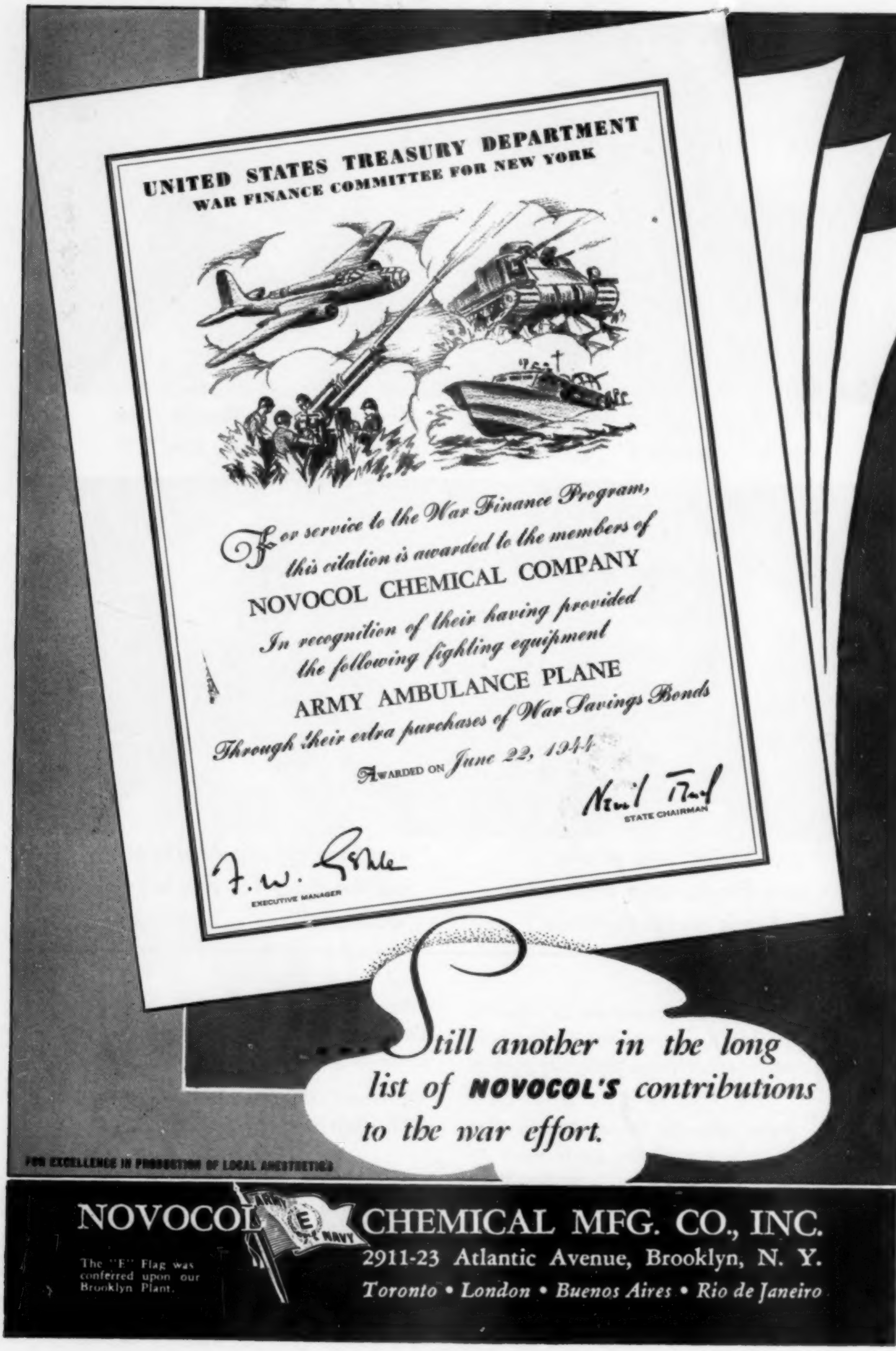
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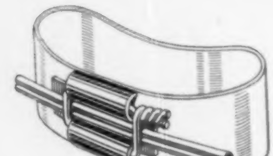

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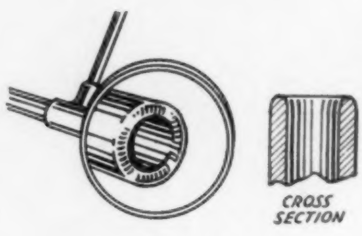

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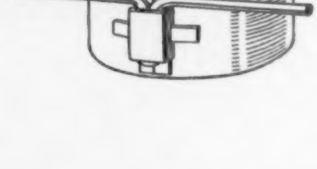

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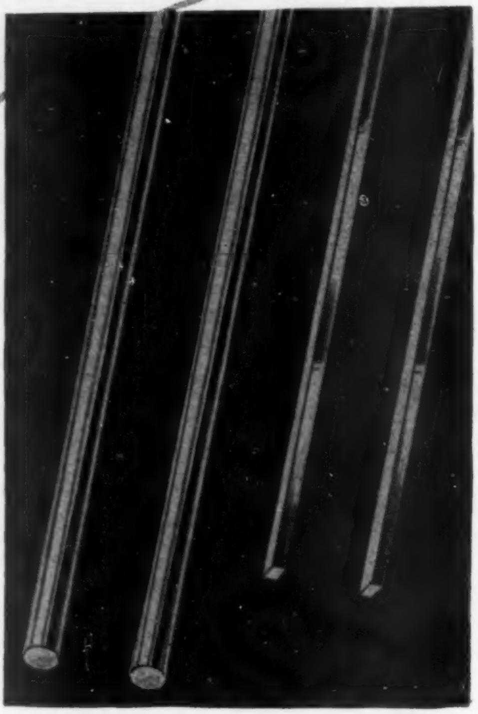

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